PLAINTIFF'S EXHIBITS

Supreme Court of the United States

OCTOBER TERM, 1954

No. 255

ALTOONA PUBLIX THEATRES, INC.,
PETITIONERS,

vs.

AMERICAN TELEVISION CORPORATION AND TELEVISION HOLDING, A. G.

No. 256

WILMER & VINCENT CORPORATION AND LOCUST STREET REAL ESTATE COMPANY, PETITIONERS,

vs.

AMERICAN TELEVISION CORPORATION AND TELEVISION HOLDING, A. G.

INDEX.

	Vol. I Page
Docket Entries (No. 971)	1
Docket Entries (No. 972)	5
Bill of Complaint (Memorandum for No. 971)	9
Amended Bill of Complaint (No. 971)	9
Answer (Memorandum for No. 971)	18
Amended Answer (No. 971)	18
Bill of Complaint (No. 972)	28
Amendment to Bill of Complaint (No. 972)	40
Answer (Memorandum for No. 972)	42
Amended Answer (No. 972)	42
Order Amending Answers	52
Statement of Evidence	53

PLAINTIFFS' WITNESSES.

Dr. Frederick Holborn—	
Direct Examination	65
Cross-Examination	71
Re-Direct Examination	77
Re-Cross-Examination	79
Dr. Josef Engl—	
Direct Examination	80
Cross-Examination	128
Re-Direct Examination	200
Re-Cross-Examination	222
John M. Joy—	
Direct Examination	222
Cross-Examination	238
Re-Direct Examination	246
William C. Ballard, Jr.—	
Direct Examination	249

Vol. I
Page

William C. Ballard, Jr. (Recalled)—
Cross-Examination 408
Re-Direct Examination 462

Dr. Josef Engl (Recalled)—
Re-Direct Examination 465
Re-Cross-Examination 468
Re-Direct Examination 473
Re-Cross-Examination 474

DEFENDANTS' WITNESSES.

Albert Kindelmann—
Direct Examination 318

Rudolph C. Kneuer—
Direct Examination 320

Albert Kindelmann (Resumed)—
Cross-Examination 321
Re-Direct Examination 328
Re-Cross-Examination 330
Re-Direct Examination 331
Re-Cross-Examination 332

Ferdinand Elsbeck—
Direct Examination 333
Cross-Examination 334
Re-Direct Examination 336
Re-Cross-Examination 336

Harry G. Wrede—
Direct Examination 337
Cross-Examination 339

Albert Kindelmann (Resumed)—
Re-Cross-Examination 341

Louis E. Hammond—
Direct Examination 341
Cross-Examination 352
Re-Direct Examination 366

Vol. I
Page

George K. Thompson—
Direct Examination 366
Cross-Examination 369
Direct Examination (by Agreement of Counsel) 478

Henry A. Taylor—
Direct Examination 373
Cross-Examination 384
Re-Direct Examination 400
Re-Cross-Examination 404
Re-Direct Examination 407

Anthony J. Webber—
Direct Examination 480
Cross-Examination 485
Re-Direct Examination 490
Re-Cross-Examination 491

Harry F. Getcliffe—
Direct Examination 491
Cross-Examination 492
Re-Direct Examination 496

William C. Duryea—
Direct Examination 497

Arthur G. Dannell—
Direct Examination 502

Charles A. Winkler—
Direct Examination 503
Cross-Examination 503
Re-Direct Examination 504

W. E. Story, Jr.—
Direct Examination 504
Cross-Examination 516
Re-Direct Examination 524

William C. Duryea (Resumed)—
Cross-Examination 526
Re-Direct Examination 530
Re-Cross-Examination 532

Vol. I
Page

Henry A. Taylor (Resumed)—
Re-Direct Examination 534

Oscar Steiner—
Direct Examination 535
Cross-Examination 543
Re-Direct Examination 551

Frank N. Waterman—
Direct Examination 557

Henry A. Taylor (Resumed)—
Re-Direct Examination 588
Re-Cross-Examination 588

Jacob T. Tschopp—
Direct Examination 589
Cross-Examination 592
Re-Direct Examination 599

Charles A. Hoxie—
Direct Examination 599
Cross-Examination 615
Re-Direct Examination 629
Re-Cross-Examination 630

Vol. II

Frank N. Waterman (Resumed)—
Direct Examination 631
Cross-Examination 694

Alfred Mueller—
Direct Examination 766
Cross-Examination 770
Re-Direct Examination 781
Re-Cross-Examination 781

Frederick C. Burt—
Direct Examination 853
Cross-Examination 854

PLAINTIFFS' WITNESSES IN REBUTTAL.

Vol. II
Page

William C. Ballard, Jr. (Recalled)—
Direct Examination 732

William C. Ballard, Jr. (Resumed)—
Direct Examination 783

William C. Ballard, Jr. (Resumed)—
Direct Examination 855

William C. Ballard, Jr. (Resumed)—
Direct Examination 935

Dr. Josef Engl (Recalled)—
Direct Examination 954
Cross-Examination 959

William C. Ballard, Jr. (Resumed)—
Cross-Examination 963
Re-Direct Examination 1019

Opinion of November 24, 1933 1027
Memorandum of Corrections of Opinion, Dated November 24, 1933 .. 1036
Plaintiffs' Proposed Findings of Fact 1037
Plaintiffs' Proposed Conclusions of Law 1078
Order 1090
Index to Defendants' Proposed Findings of Fact and Conclusions of Law 1091
Defendants' Proposed Findings of Fact and Conclusions of Law 1101
Order 1129
Interlocutory Decree (No. 971) 1130
Petition for Appeal (No. 971) 1133
Order Allowing Appeal and Supersedeas Order (No. 971) 1133
Assignment of Errors (No. 971) 1135
Bond for Costs on Appeal and Supersedeas (No. 971) 1136
Citation (No. 971) 1138
Interlocutory Decree (No. 972) 1139
Petition for Appeal (No. 972) 1143
Order Allowing Appeal and Supersedeas Order (No. 972) 1144

Vol. II
Page

Assignment of Errors (No. 972) 1145
Bond for Costs on Appeal and Supersedeas (No. 972) 1147
Citation (No. 972) 1149
Order Approving Record 1150
Stipulated Præcipe for Record on Appeal 1151
Stipulation as to Correctness of Record 1154
Clerk's Certificate 1155
Proceedings in U. S. C. C. A., Third Circuit **1156**
Minute Entry of Argument and Submission **1156**
Opinion, Buffington, J. **1157**
Judgment, Case No. 5392 ..... **1173**
Judgment, Case No. 5393 ..... **1173**
Clerk's Certificate **1174**
Opinion, Per Curiam, on Request to Change Opinion **1175**
Order Correcting Opinion **1180**
Orders Allowing Certiorari **1182**

INDEX TO PLAINTIFFS' EXHIBITS.

Ex. No.	Description	Offered Vol. I Page	Printed Vol. III Page
1	Certified Copy of File Wrapper and Contents of Patent in Suit, Including Copy of Patent in Suit	53	1
1-A	Book of Patent References Cited in Prosecution of Application of Patent in Suit	53	123
2	Certified Copy of Disclaimer Re Patent in Suit	53	227
3	Certified Copy of Vogt, et al., German Application, Filed May 22, 1920, and Translation	53	230
4	Certified Copy of Vogt, et al., German Application, Filed March 24, 1921, and Translation	53	242
5	Certified Copy of Vogt, et al., German Application, Filed April 9, 1921, and Translation	54	254
6	Certified Copy of Vogt, et al., German Application, Filed January 23, 1922, and Translation	54	263
7	Vogt, et al., United States Patent No. 1,590,185	54	269
8	Certified Copy of File Wrapper and Contents, Vogt, et al., U. S. Application Ser. No. 458,626, Filed April 4, 1921	54	...
9	Certified Copy and Translation, Vogt, et al., German Application of March 3, 1919	54	...
10	Certified Copy of Decision and Findings of Judge Adkins, Supreme Court, District of Columbia	55	276
11	Certified Copy, Vogt, et al., Belgium Patent No. 292,863, and Translation	55	...
12	Copy of Vogt, et al., French Patent No. 532,651, Published February 9, 1922, With Translation	55	...
12-A	Certified Copy Vogt, et al., German Application, Filed April 16, 1919, With Translation	55	...
13	Correspondence Between Ward, Crosby & Smith, et al., and R. C. A., etc.	57	301
14-A	Certified Copy of Assignment From Vogt, et al., to Tri-Ergon, Ltd., Dated June 3, 1924, Referring to Application for Patent in Suit as Serial No. 545,377	58	...

Ex. No.	Description	Offered Vol. I Page	Printed Vol. III Page
14-B	Photostat of Agreement and Assignment Between Tri-Ergon, A. G., and William Fox, Dated September 4, 1928, With Schedule of Patents and Applications, Including Application Serial No. 545,377 for Patent in Suit; and Attached Copy of License to Tri-Ergon Musik, A. G., Including Schedule of Patents and Applications	58	...
14-C	Translation of License to Tri-Ergon Musik, A. G., Attached to Exhibit 14-B	58	...
14-D	Photostat of Assignment From Tri-Ergon, A. G., to William Fox, Dated February 15, 1929	58	...
14-E	Photostat of Assignment From William Fox to American Tri-Ergon Corporation, Dated June 6, 1930, Referring to Patent in Suit by Number and by Serial Number of Application Therefor	59	...
14-F	Photostat of Agreement Between Tri-Ergon Musik, A. G., and Tri-Ergon Holding, A. G., Dated November 10, 1931, and Attached to "A. E. G." License Re Foreign Rights, and Translation of Said License	59	...
14-G	Photostat of Agreement Between Tri-Ergon, A. G., and Tri-Ergon Holding, A. G., Dated November 10, 1931	59	...
15	Stipulation Between Counsel Covering Various Formal Matters and Certain Details and Diagrams of Defendants' Apparatus	59	...
15-A to 15-F, Inclusive	Diagrams (Photostats) Attached to Stipulation	59	327
16-A to 16-F, Inclusive	Charts of Defendants' Alleged Infringing PS1 Apparatus; D to F, Charts of Defendants' Alleged Infringing PS16 Apparatus	65	...
17	Photostat Showing Vogt, et al., Sound and Picture Reproducing Machine Used in Alhambra Theatre Demonstration, Berlin, September, 1922	121	335

Ex. No.	Description	Offered Vol. I Page	Printed Vol. III Page
18	Photostat Showing Early Vogt, et al., Sound Recording and Reproducing Machine	121	336
19	Photostat Showing Another View of Same	121	337
19-A	Photostat Showing Early Vogt, et al., Sound and Picture Recording and Reproducing Machine	121	338
20	Strip of Specially Perforated Sound and Picture Film, 1923 (Physical)	101	...
21	Short Strip of Standard Film (Physical)	102	...
22	Sample Invitation Card for Vogt, et al., Alhambra Theatre Demonstration, Berlin, September 27, 1922 (Translation in Pencil on Reverse Side)	104	341
23	Photograph of One of Twenty-five Vogt, et al., 1924-1925 Sound Picture Heads	108	343
24	Another View of Same	108	344
25	Slip From Patentee's Notebook Showing Photographed Image of Typical Narrow Slits Tested, April, 1921 (Physical)	112	...
26	Copy of Vogt, et al., U. S. Amplifier Tube Patent 1,587,786 (Application Filed in U. S. April 4, 1921; in Germany December 2, 1919)	121	347
27-A, 27-B	Prints Showing One of Vogt, et al., 1925 Sound Picture Heads as Brought to America in 1926	124	353
28	Cut of Vogt, et al., Tri-Ergon Five-Element "Pentode" Tube Referred to by Witness Engl	221	355
29, 30, 31	Photographs of Plaintiffs' Exhibit 93 Machine, Showing One of Twenty-five Vogt, et al., 1924-1925 Sound Picture Heads as Modified as per Figure 2 of Patent in Suit	237	356
32	Pencil Sketch Made by Witness Ballard Showing Irregular Areas Occurring Adjacent Film Perforations	317	359
33	Sample Vogt, et al., Flywheel From One of Twenty-five Vogt, et al., Machines, and of the Same Shape and Design as Brought to U. S. by Dr. Engl in 1926-1927 (Physical)	468	...

INDEX TO PLAINTIFFS' EXHIBITS—Continued.

Ex. No.	Description	Offered Vol. I Page	Printed Vol. III Page
34-A	Page 1, Vol. 6, Senate Documents, First Session 67th Congress, Comprising Message From the President to the U. S. Senate Re Treaty of Berlin	476	...
34-B	Page 11 to End of Volume of Above Vol. 6, Comprising Versailles Treaty	476	...
34-C	Government Publication, "Treaty Series No. 658 Re Treaty of Berlin and Treaty of Versailles"	476	...
34-D	Congressional Record, Vol. 61, No. 131 of 1921, Pages 7113-7116, 7121-7122; and Vol. 61, No. 132, Page 7173, Comprising Debates Re Treaty of Berlin	477	...
		Vol. II	Vol. III
35	Steiner General Electric Patent 1,817,781	931	363
36	Copy of File Wrapper and Contents of Application for Above Steiner Patent	931	...
37	(For Identification)—Sketch Made by Witness Tschopp (Defts'. Ex. 49; to be Reproduced With Defts'. Exhs. and Marked With Both Numbers)	599	...
38	Copy of Hoxie General Electric Patent No. 1,756,864	930	369
39	Certified Copy of File Wrapper and Contents, Hoxie Patent No. 1,758,794	1021	...
40	Copy of Bardy Patent No. 1,258,298	930	377
41 and 42	Photographs of Bell & Tainter Machine in Smithsonian Institution in Washington	929	393
43	Edison Phonograph Catalogue of October 1, 1911, Showing Construction of "Triumph" Machine	743	395
44	Article by Edward W. Kellogg, on Page 653 to 670, Inclusive, of Journal of Society of Motion Picture Engineers, Issue of November, 1930	763	416
45	Maurer RCA Patent No. 1,891,387	764	435
46	Pencil Drawings Comparing Figure 1 of Vogt, et al., German Patent No. 387,058 and Defendant-ants' Alleged Model Thereof	945	447

INDEX TO PLAINTIFFS' EXHIBITS—Continued.

Ex. No.	Description	Offered Vol. II Page	Printed Vol. III Page
47	Article From "Power" of May 3, 1921, by Professor Trowbridge, Entitled "A New Type of Indicator for High Speed Internal Combustion Engines" ..	891	448
47-A, 47-B, 47-C	Photographs of Machine in Smithsonian Institution of Type Corresponding Generally to Figure 1 of Bell & Tainter Patent No. 341,214	930	453
48	Article by Johannes Rolle in the Licht Bild Theatre Besitzer, Entitled "The Film as a Carrier of Sound Waves," in 1922, Issue No. 49, and Translation Thereof	930	457
49	Copy of Heisler Patent No. 1,758,832	931	471
50	Copy of Heisler Patent No. 1,768,403	931	477
51	Copy of Kellogg Patent No. 1,780,681	931	483
52	Copy of Heisler Patent No. 1,808,551	931	487
53	Copy of Kellogg Patent No. 1,827,588	931	495
54	Copy of File Wrapper and Contents of Heisler Patent No. 1,831,562	932	...
55	Copy of Heisler Patent No. 1,839,151	932	503
56	Copy of File Wrapper and Contents of Taylor Patent No. 1,847,636	932	...
57	Copy of Maurer Patent No. 1,891,388	932	511
58	Copy of File Wrapper and Contents of Page Patent No. 1,892,218	932	...
59	Copy of Kellogg Patent 1,892,554	932	521
60	Copy of Robinson Patent No. 1,880,106	932	529
61	Copy of File Wrapper and Contents of Cawley Patent No. 1,878,577, Ser. No. 357,259, Filed April 23, 1929	933	...
62	Copy of File Wrapper and Contents of Cawley Patent No. 1,594,662, Application Filed as Ser. No. No. 328,299, Allegedly Filed October 3, 1919	933	...
63	Certified Copy of Full-Sized Drawings as Originally Filed October 3, 1919, in Cawley Application No. 328,299	933	...

Ex. No.	Description	Offered Vol. II Page	Printed Vol. III Page
64	Copy of File Wrapper and Contents of Cawley Patent No. 1,420,304, Application Filed December 13, 1919, Ser. No. 344,708	933	...
65	Certified Copy of File Wrapper and Contents of Cawley Patent No. 1,698,536, Application Filed Juy 21, 1923, Ser. No. 653,704	933	...
66	Certified Copy of File Wrapper and Contents of Cawley Patent No. 1,816,360, Application Filed January 8, 1921, Ser. No. 435,983	934	...
67	Certified Copy of File Wrapper and Contents of Cawley Patent No. 1,825,439, Application Allegedly Filed September 18, 1929, Ser. No. 393,072	934	...
68	Certified Copy of File Wrapper and Contents of Cawley Patent No. 1,825,441, Application Allegedly Filed January 8, 1921, Ser. No. 435,984	934	...
69	Certified Copy of File Wrapper and Contents of Cawley Patent No. 1,825,438, Application Allegedly Filed September 16, 1929, Ser. No. 393,071	934	...
70	Certified Copy of Assignment as Recorded From Aloysius Cawley to Radio Corporation of America, Recorded in U. S. Patent Office, Liber R/140, Page 318 of Transfers of Patents	934	537
71	Certified Copy of Assignment From Aloysius Cawley to RCA Recorded in Liber R/140, Page 315 of Transfers of Patents	934	541
72	Assembly From RCA PS1 Apparatus, Comprising a Gear Plate and Two Springs Removed From Flywheel Assembly (Physical)	935	...
73	Sample Simplex 15-Tooth Takeup Sprocket (Physical)	935	...
74	Sample Motion Picture Film Sprocket Having 32 Teeth at Each Edge (Physical)	935	...
75	(See Exhibit No. 94.)		
76	File Wrapper of the Pfannenatiehl Patent No. 1,728,304	953	...

Ex. No.	Description	Offered Vol. II Page	Printed Vol. III Page
77	Sheet in Patentees' Notebook Between May 11 and May 20, 1921, and Translation Thereof	955	...
78	Photographic Slip Dated May 5, 1921, From Patentees' Notebook Showing Photographed Images of Typical Narrow Slits Tested (Similar to Plaintiffs' Ex. 25) and Translation	955	...
79	Sheet From Patentees' Notebook, February 10, 1921, and Translation	955	...
80	Additional Sheet in Patentees' Notebook Dated February 10, 1921, and Translation	955	...
81	Sheet in Patentees' Notebook Showing Linear Relationship Between Glow Discharge Current and Density, Dated January 26, 1921, and Translation	956	...
82	Page Dated January 26, 1921, in Patentees' Notebook, Including Curve Sheet Signed by Dr. Engl and Showing Linear Relationship Between P. E. Cell Currents and Slit Opening and Translation	957	...
83	Sheet in Patentees' Notebook, Dated September 23, 1920, and Translation, Showing Optical Slit Arrangements and Translation	957	...
84	Article in General Electric Review, September, 1928, Entitled "Characteristics of Photoelectric Tubes," by Dr. Koller and H. A. Breeding	1021	547
85	Article From Science Abstracts, 1915, Section A, Published January 17, 1916, Entitled "Persistence of the Current in Photoelectric Cells After the Suppression of the Exciting Light"	1021	551
86	Article by Herbert E. Ives in Astro-Physical Journal of November 7, 1917, Found at Pages 241 to 248	1021	552
87	Copy of File Wrapper and Contents of Heisler Patent No. 1,771,922	1021	...
88	Copy of File Wrapper and Contents of Heisler Patent No. 1,793,399	1021	...

Ex. No.	Description	Offered Vol. II Page	Printed Vol. III Page
89	Tri-Ergon Sound and Picture Head, Corresponding to Figures 3, 4, 5 and 6 of Patent in Suit, as Demonstrated (Physical)	1022	...
90-A, 90-B	Photographs of Exhibit 89	1022	563
91	Pair of New Helical Gears Referred to by Witness Ballard and Used in Last Demonstration of Plaintiffs' Exhibit 89 Machine (Physical)	1022	...
92	Spring Used Between Flywheel and Arm in Plaintiffs' Last Demonstration of Exhibit 89 Machine (Physical)	1022	...
93	Sound and Picture Head of Second Tri-Ergon Machine as Demonstrated, With Film Movement Representing Figure 2 of Patent in Suit (Physical)	1023	...
94	Page 301 Only of the Transactions of Society of Motion Picture Engineers, Vol. XI, No. 30 of 1927, Referred to by Witness Ballard (This Exhibit Also Received in Evidence as Plaintiffs' Exhibit No. 75)	1023	567

INDEX TO DEFENDANTS' EXHIBITS.

Ex. No.	Description	Offered Vol. I Page	Printed Vol. IV Page
1	Simplex Projector Head, Model 100, of The Precision Machine Co., Inc. (Physical)	319	...
2	Copy of 1914-1915 Catalogue of The Precision Machine Co., Inc.	319	571
3	Section Model of Simplex Projector (Physical)	320	...
4	Copy of Page of Sales Record Book of the International Projector Corporation, Referred to by Witness Kneuer	321	587
5	Modern Simplex Projector Demonstrated by Witness Kindelmann (Physical)	330	...
6	Copy of 1910 Catalogue of Nicholas Power Company	333	591
7	Section Model of Power's Intermittent Movement (Physical)	334	...
8	Power's Projector Head (Physical)	339	...
9-A	Copy of Page of Sales Record Book of Nicholas Power Company Showing First Shipment of Model No. 6 Power's Projector	338	611
9-B	Copy of Page of Above Sales Record Book Showing Sale of Projector Head No. 24,526 (Defendants' Exhibit No. 8)	338	612
9-C	Copy of Page of Above Sales Record Book Showing Sale of Intermittent Movement No. 26,506 (Defendants' Exhibit No. 8)	338	613
10	Copy of Catalogue of Edison Kinetoscopes	339	615
11	Edison Kinetophone (Physical)	345	...
12	Edison Kinetoscope (Physical)	347	...
13-A to 13-E	Newspaper Clippings Referred to by the Witness Hammond	347	625
13-F	Article in Munsey's Magazine of March, 1913, Referring to the Edison Kinetophone	350	631
14	Lease Between American Tel. & Tel. Co. and Edison Company With Attached List of Materials	368	637

Ex. No.	Description	Offered Vol. I Page	Printed Vol. IV Page
15	Photograph of Original Kinetophone Used at San Francisco Fair	369	643
16	Photograph Showing Application of Edison Synchronizer to a Power Projector	369	645
17	Tracing Entitled "Assembly Recording Machine, Kinetophone, Edison Laboratory," Dated October 4, 1913	374	...
18	Tracing af Balance Wheel of Kinetophone Recording Machine, Dated October 1, 1913	376	...
19-A	Material List for Recording Machine 896, Edison Laboratory, Dated October 7, 1913	376	...
19-B to 19-LLL, Inclusive	Sixty-three Drawings Comprising Sub-Assembly and Detail Drawings of Edison Kinetophone Referred to by Witness Taylor	535	...
20	Photograph Showing Camera and Synchronizer Driven by Motor, Referred by Witness Taylor	377	649
21	Drawing Entitled "Kinetoscope Recording Machine Pedestal"	378	650
22	Photograph Showing Synchronizer of the Kinetoscope	381	651
23	Copy of Letter of January 14, 1915, to Witness Taylor in Vienna From Chief Engineer of Edison Company Regarding the Fire at Kinetophone Studio	381	653
24	Copy of Letter of March 2, 1915, From Imperial Counsel to Imperial Royal Police, Vienna, Re Witness Taylor Leaving Vienna	382	656
25	Cylindrical Record Entitled "The Birth of the Telephone," by Thomas A. Watson (Physical)	479	...
26	Cylindrical Record Entitled "The Edison Minstrels" (Physical)	479	...
27	Two Pieces of Film Made in Vatican, Rome, June, 1914 (Physical)	384	...

Ex. No.	Description	Offered Vol. I Page	Printed Vol. IV Page
28	Ernemann Projector Marked "Ernemann II" (Physical)	478	...
29	Sketch Made by Witness Engl of Disclosure of German Patent No. No. 387,058	478	659
30	Sketch Made by Mr. Neave and Referred to by Witness Engl	478	660
31	Edison Triumph Model Reproducing Machine (Physical)	492	...
32	Separate Motor for Edison Triumph Machine (Physical)	496	...
33	Belt for Edison Triumph Machine (Physical)	496	...
34	Recording Element for Edison Triumph Machine (Physical)	484	...
35-A, 35-B	Sketches by Witness Webber Illustrating the Method of Applying the Recording Arm on the Edison Triumph Machine	484	663
36	Duryea-Trowbridge Oscillograph (Physical)	500	...
37	Specimen of Record Made on Duryea-Trowbridge Oscillograph (Physical)	500	...
38	Strip of Paper With Black Line Indicating the Approximate Size of the Line of Light From the Cylindrical Lens of the Duryea-Trowbridge Oscillograph (Physical)	500	...
39	Type 11 Victrola (Physical)	504	...
40	Copy of Pages From Dr. Story's Notebooks; Notebook No. 3—Pages 23, 25, 56, 57, 58, 61, 73, 74; Notebook No. 4—Pages 220, 221, 226, 252, 253, 263, 264, 270, 278, 283, 284	515	667
41	Hull Patent No. 1,313,187	524	687
42	Sketch of Kinetophone Reproducing Machine Made by Witness Taylor	535	693
43	Hoxie Combined Camera and Reproducer (Physical)	589	...
44	Oscillograph Motor and Attached Flywheel (Physical)	589	...

Ex. No.	Description	Offered Vol. I Page	Printed Vol. IV Page
45	Hoxie Reproducer (Physical)	589	...
46	Photoelectric Cell Similar to the Type Used Originally With the Preceding Hoxie Machines (Physical)	589	...
47	Pliotron Similar to That Used by Hoxie (Physical)	589	...
48	Copies of Pages 134 to 141, Inclusive, of Time Book Kept by Witness Tschopp, Entries From February 10, 1921, to April 16, 1921	592	697
49	Sketch of Flyball Governor Made by Witness Tschopp	599	701
50	Sketch of Arrangement for Talking Motion Pictures Made by Witness Hoxie, December 12, 1920	603	702
51	Original Hoxie Record Entitled "A New Type of Phonograph," Record Dated March 9, 1921 (Physical)	606	...
52	Photograph No. 116072, Dated July 21, 1921, of Hoxie Reproducer (Defendants' Exhibit No. 45)	609	705
53	Photograph No. 116688, Dated December 1, 1921, of Hoxie Combined Camera and Reproducer (Defendants' Exhibit No. 43)	609	706
54	Photograph No. 116687, Dated December 1, 1921, of Hoxie Combined Camera and Reproducer (Defendants' Exhibit No. 43)	609	707
55	Photograph No. 118879, Dated January 11, 1923, of Machine Entitled "Pallophotophone Recorder"	610	708
56	Photograph No. 118878, Dated January 11, 1923, of Machine Entitled "Pallophotophone Reproducer"	610	709
57	Newspaper Clipping of February 18, 1923, Showing Model No. 177 Machine and Mr. Hoxie	610	710
58	Photograph No. 505093, Dated April 17, 1928, of Machine Entitled "Pallophotophone Construction"	610	711
59	Photograph No. 505092, Dated April 17, 1928, of Machine Entitled "Pallaphotophone Construction"	610	712
60	Photograph No. 120231, Dated July 6, 1923, of Pallophotophone Recorder Model No. 205	610	713

Ex. No.	Description	Offered Vol. I Page	Printed Vol. IV Page
61	Photograph No. 120232, Dated July 6, 1923, of Pallophotophone Recorder Model No. 205	610	714
62	Photograph No. 120490, Dated August 28, 1923	610	715
63	Photograph No. 435433, Dated January 28, 1926, of Pallophotophone Reproducer	610	716
64	Photograph No. 500215, Dated July 13, 1926, of Talking Motion Picture Recorder, Model 291	610	717
65	Photograph No. 500216, Dated July 13, 1926, of Talking Motion Picture Recorder, Model 291	610	718
66	Photograph No. 500166, Dated July 7, 1926, of Demonstration of Talking Pictures	610	719
67	Sketch Made by Mr. Hoxie on December 12, 1920, Showing Proposed Arrangement for Making Master Phonograph Records	615	720
Ex. No.		Vol. II	Vol. IV
68	Diagram of RCA Victor Photophone Recording System	634	721
69	Diagram of RCA Victor Photophone Reproducing System	634	723
70	Specimens of Sound Records of Variable Area and Variable Density Types	637	725
71	Copy of Title Page and Pages 407, 408, 409 and 410 of Book Entitled "A Manual of Machinery and Millwork," by Rankine	647	726
72	Model Demonstrated by Witness Waterman to Show Damping of Springs and Phonograph Turntables (Physical)	673	...
73	File Wrapper and Contents of Edison Patent No. 227,679, Granted May 18, 1880	792	...
74	Defendants' Prior Art Book No. 1	794	731c
75	Defendants' Prior Art Book No. 2	796	731c
76	Defendants' Alleged Infringing Apparatus PS1, Including Turntable and Stand (Physical)	796	...

INDEX TO DEFENDANTS' EXHIBITS—Continued.

Ex. No.	Description	Offered Vol. II Page	Printed Vol. V Page
76-A	Photograph of PS1 Apparatus, Defendants' Exhibit No. 76	796	1413
77	Defendants' Alleged Infringing Apparatus PS16 (Physical)	796	....
77-A	Photograph of PS16 Apparatus, Defendants' Exhibit No. 77	796	1417
78	Defendants' Model of Figure 1 of Vogt, Massolle and Engl German Patent No. 387,058 (Physical)	797	....
78-A, 78-B, 78-C	Photographs of Model of German Patent No. 387,058, Defendants' Exhibit No. 78	797	1421
79	Defendants' Model of Figure 5 of Patent in Suit (Physical)	798	....
79-A, 79-B, 79-C	Photographs of Model of Figure 5, Defendants' Exhibit No. 79	798	1429
80	Defendants' Machine in Which Models of German Patent No. 387,058 and Figure 5 of Patent in Suit Were Demonstrated (Physical)	798	....
80-A	Photograph of Defendants' Machine, Defendants' Exhibit No. 80	798	1437
81	Defendants' Model of Amet Drive, as Demonstrated in Place of Spring Drive of Figure 5 of Patent in Suit (Physical)	799	....
81-A	Photograph of Amet Drive, Defendants' Exhibit No. 81	799	1441
82	Defendants' Model of Spring Drive of Constable Patent No. 1,425,177, as Demonstrated, in Place of Spring Drive of Figure 5 of Patent in Suit (Physical)	799	....
82-A	Photograph of Constable, Drive, Defendants' Exhibit No. 82	799	1445
83	Defendants' Model of Machine of Constable Patent No. 1,425,177 (Physical)	800	....
83-A, 83-B, 83-C	Photographs of Constable Model, Defendants' Exhibit No. 83	800	1449
84	Defendants' Model Referred to as Edison Skeleton Model (Physical)	801	....

INDEX TO DEFENDANTS' EXHIBITS—Continued.

Ex. No.	Description	Offered Vol. II Page	Printed Vol. V Page
84-A	Photograph of Edison Skeleton Model, Defendants' Exhibit No. 84	801	1457
85	Defendants' Model of Bell & Tainter Patent No. 341,214 (Physical)	802	....
85-A, 85-B	Photographs of Bell & Tainter Model, Defendants' Exhibit No. 85	802	1461
86	Defendants' Model of French Patent No. 472,467 to Dragoumis, et al. (Physical)	802	....
86-A	Photograph of Dragoumis Model, Defendants' Exhibit No. 86	802	1467
87	Defendants' Model Referred to as Reel Film Model (Physical)	803	....
87-A	Photograph of Reel Film Model, Defendants' Exhibit No. 87	803	1471
88	Defendants' Model of French Patent No. 414,788 to Compagnie de Phonographe, et al. (Physical)	804	....
88	Photograph of French 414,788 Model and Victrola, Defendants' Exhibits Nos. 88 and 39, Respectively	804	1475
89-A to 89-K	Cylindrical Disc and Film Records Used at Defendants' Demonstration (Physical) as follows:		
	89-A—Cylindrical Record With Speech and Waltz for Edison Kinetophone (Defendants' Exhibit No. 11)	804	....
	89-B—Cylindrical Record With Piano for Edison Kinetophone	804	....
	89-C—Cylindrical Record With 512 Cycles for Edison Kinetophone	804	....
	89-D—Cylindrical Record With Speech, Waltz and Piano for Edison Triumph (Defendants' Exhibit No. 31)	804	....
	89-E—Cylindrical Record With 512 Cycles for Edison Triumph	804	....

Ex. No.	Description	Offered Vol. II Page	Printed Vol. V Page
	89-F—Thin Cylindrical Record With Speech for Edison Triumph	804	....
	89-G—Thin Cylindrical Record With Waltz for Edison Triumph	804	....
	89-H—Film With Speech and Waltz for Reel Film Machine (Defendants' Exhibit No. 87)	804	....
	89-I—Film Loop With Waltz for Edison Skeleton Machine (Defendants' Exhibit No. 84)	804	....
	89-J—Film Loop With Speech and March for Dragoumis Machine (Defendants' Exhibit No. 86)	804	....
	89-K—Victor Record With Hungarian Rhapsody for General Phonograph and Victrola (Defendants' Exhibits Nos. 88 and 39, Respectively)	804	....
	89-R—Photograph of Defendants' Exhibits Nos. 25, 26, 51, 89-A to 89-K, and Other Records and Films	807	1481
	89-S—Photograph of Edison Kinetophone, Defendants' Exhibit No. 11, as Demonstrated With Mechanical Reproduction	807	1483
	89-T—Photograph of Edison Kinetophone, Defendants' Exhibit No. 11, as Demonstrated With Electrical Reproduction	808	1485
	89-U—Photograph of the Edison Triumph Machine, as Demonstrated With Electrical Reproduction	809	1487
	89-V—Photograph of Hoxie Reproducer, Defendants' Exhibit No. 45, as Operated at Defendants' Demonstration	809	1489
	89-W—Photograph of Room at Jermyn Hotel in Which Machines Were Located at Time of Defendants' Demonstration	809	1491
	89-X—Photograph of Adjoining Room Wherein Parties Heard Reproductions	810	1493

INDEX TO DEFENDANTS' EXHIBITS—Continued.

Ex. No.	Description	Offered Vol. II Page	Printed Vol. V Page
90-A, 90-B	—File Histories, Including Applications as Originally Filed, of Clark Patents Nos. 1,367,663 and 1,388,515	810	....
91	—File History, Including Application as Originally Filed, of Constable Patent No. 1,425,177	810	....
92	—Application as Originally Filed of Trowbridge Patent No. 1,447,913	811	....
93	—Application as Originally Filed of Ries Patent No. 1,473,976, Granted November 13, 1923, and Ries Patent No. 1,607,480, Granted November 16, 1926, Both Being Based Upon One Application, Serial No. 769,114, Dated March 12, 1913	811	....
94	—Application as Originally Filed of Cawley Patent No. 1,710,677, Granted April 23, 1929, and Cawley Patent No. 1,878,577, Granted September 20, 1932, Both Patents Being Based Upon the Same Original Application, Serial No. 328,299, Filed October 3, 1919	813	1495
95	—Application as Originally Filed of Cawley Patents Nos. 1,825,438, 1,825,439, 1,825,440 and 1,825,441, Granted September 29, 1931, All Four Patents Being Based Upon the Same Original Application, Serial No. 435,984, Filed January 8, 1921	813	1517
96	—Application as Originally Filed of Kunz Patent No. 1,381,474, Granted June 14, 1921	814	....
97	—Application as Originally Filed of Compton Patent No. 1,567,424, Granted December 29, 1925	814	....
98	—File History and Contents of German Patent No. 387,058 to Vogt, Massolle and Engl, With Translation	814	....
99	—Nullity Proceedings in German Patent Office, Entitled "Herman Greiff v. Tri-Ergon Holding, A. G., et al., and Electrical Research Products, Inc., v. Tri-Ergon Holding, A. G., et al." Relating to German Patent No. 387,058, With Translations	815	....

INDEX TO DEFENDANTS' EXHIBITS—Continued.

Ex. No.	Description	Offered Vol. II Page	Printed Vol. V Page
100	File History of German Patent No. 389,317 to Massolle, Vogt and Engl, With Translation	815	....
101	Nullity Proceedings in German Patent Office Re German Patent No. 389,317 to Massolle, Vogt and Engl, With Translation	815	....
102	File History and Contents of German Patent No. 389,318 to Massolle, Vogt and Engl, With Translation	815	....
103	Nullity Proceedings in German Patent Office Re German Patent No. 389,318 to Massolle, Vogt and Engl, With Translation	816	....
104	File History of German Patent No. 389,319 to Massolle, Vogt and Engl, With Translation	816	....
105	Nullity Proceedings in German Patent Office With Respect to German Patent No. 389,319 to Massolle, Vogt and Engl, With Translation	816	....
106	German Patent No. 387,058 to Vogt, Massolle and Engl, With Translation	816	1543
107	German Patent No. 389,317 to Massolle, Vogt and Engl, With Translation	817	1549
108	German Patent No. 389,318 to Massolle, Vogt and Engl, With Translation	817	1553
109	German Patent No. 389,319 to Massolle, Vogt and Engl, With Translation	817	1559
110	British Patent No. 178,133 to Massolle, Vogt and Engl, Accepted January 4, 1923	817	1565
111	British Patent Office Certificate, Containing Application as Open to Public Inspection of British Patent No. 178,133 to Massolle, Vogt and Engl, Corresponding Application as Originally Filed in Germany and Translation, and Assignment of August 16, 1924, From Patentees to Tri-Ergon, A. G., Zurich	818	....

INDEX TO DEFENDANTS' EXHIBITS—Continued.

Ex. No.	Description	Offered Vol. II Page	Printed Vol. V Page
112	German Patent No. 417,967 to Vogt, Engl and Massolle, Filed March 14, 1919, Granted August 22, 1925, With Translation	818	1569
113-A, 113-B	Two Nullity Decisions of German Patent Office Re German Patent No. 417,967 to Vogt, Engl and Massolle, With Translations	819	....
114	Certificate of Smithsonian Institution Re Berliner Gramophones and Bell & Tainter Machines	820	1575
115-A, 115-B, 115-C, 115-D	Certificate and Three Photographs of Machine Known as "Berliner Gramophone With Clark's Improvement, Museum No. 253,757," Received by Smithsonian Institution April 6, 1909	820	1583
116-A, 116-B, 116-C, 116-D	Certificate and Three Photographs of Machine Known as "Berliner Gramophone, Museum No. 307,204," Received by the Smithsonian Institution on January 14, 1921	821	1591
117-A, 117-B, 117-C, 117-D	Certificate and Three Photographs of Machine Known as "Bell & Tainter Machine, Museum No. 287,660," Received by Smithsonian Institution November 30, 1926	822	1599
118-A, 118-B, 118-C, 118-D	Certificate and Three Photographs of Machine Known as "Bell & Tainter Machine, Museum No. 287,653," Received by Smithsonian Institution November 30, 1930	822	1607
119-A, 119-B, 119-C, 119-D	Certificate of Smithsonian Institution, Consisting of Four Sheets, Showing Receipt of "Instruction for the Management and Operation of Edison's Speaking Phonograph"	822	1615
120-A, 120-B	Certificate of Smithsonian Institution Certifying Copy of Above "Instruction," etc.	822	1621
121	Separate Film Gate of Defendants' Machine PS1 (Physical)	823	....
122	Separate Flywheel Assembly of Defendants' Machine PS1 (Physical)	823	....

INDEX TO DEFENDANTS' EXHIBITS—Continued.

Ex. No.	Description	Offered Vol. II Page	Printed Vol. V Page
123	Separate Film Gate of Defendants' Machine PS16 (Physical)	823	....
124	Separate Flywheel of Defendants' Machine PS16 (Physical)	823	....
125	Separate Guide Roller of Defendants' Machines PS1 and PS16 (Physical)	823	....
126	File History and Contents of Engl, Massolle and Vogt United States Patent No. 1,590,185	824	....
127	Page 25 of "Variety" Issue of Tuesday, December 1, 1931, Containing "Notice to the Sound Film Industry," of Plaintiff, American Tri-Ergon Corp.	824	1633
128	Article Entitled "The Talking Film According to the Tri-Ergon Process," Hans Vogt—Zeitschrift des Vereines Deutscher Ingenieure, Vol. 70, No. 6, February 6, 1926, Pages 199-204, With Translation	824	1634
129	Article Entitled "The Sound Production Means of the Picture—Tonfilm," Hans Vogt—Filmtechnik, Vol. 5, April 27, 1929, Pages 202-205, With Translation	825	1657
130	Article by Hans Vogt in Film-Kurier of February 6, 1932, With Translation	825	1671
131	Article Entitled "Acoustic Film," Electrotechnische Zeitschrift, Vol. 43, December 29, 1922, Pages 1540-1541, With Translation	825	1675
132	Article Entitled "The Sounding Film," Arthur Furst, Berliner Tageblatt, No. 421, September 19, 1922, With Translation	825	1683
133	Sketch by Witness Waterman, Illustrating Ernemann Projector, Defendants' Exhibit No. 28	826	1689
134	Sketch by Witness Waterman, Illustrating Intermittent Movement of Ernemann Projector, Defendants' Exhibit No. 28	826	1690
135	Patents of Vogt, Massolle and Engl, Listed at Record, Pages 1602-1603	841	....

INDEX TO DEFENDANTS' EXHIBITS—Continued.

Ex. No.	Description	Offered Vol. II Page	Printed Vol. V Page
136	Binder of Patents Cited During Prosecution in German Patent Office of German Patents Nos. 387,058, 389,317, 389,318 and 389,319; and in Nullity Proceedings In Re Same Four German Patents; and Patents Cited in the Nullity Decisions With Respect to German Patent No. 417,916, With Translations	835	....
137	Title Page and Pages 43 and 45 of Brief of Party Vogt, et al., in U. S. Court of Customs and Patent Appeals in Interference No. 53,103, "DeForest, et al., v. Vogt, et al."	836	1692
138	Transcript of Trial Minutes and Briefs for Plaintiffs in American Tri-Ergon Corporation, et al., v. Robertson, Equity No. 47,904, in Supreme Court of District of Columbia	836	.....
139	Article Entitled "Sodium Amalgam for Photoelectric Experiments," by Elster and Geitel in "'Annalen der Physik," New Series, Vol. XLI, No. 10, 1890, With Translation	836	1697
140	British Patent No. 3,701 of 1908 to Polyphos	837	1705
141-A, 141-B	Application as Originally Filed of DeForest Patent No. 1,466,701, and Copy of Patent as Issued September 4, 1923	837	....
142	Letter of Albert G. Davis to Ira J. Adams, Dated August 20, 1925	837	1709
143-A, 143-B	Application as Originally Filed of Nicholson Patent No. 1,470,696, October 16, 1923, and Copy of Patent as Issued	838	....
144	File History of the Bell & Tainter Patent No. 341,213 of May 4, 1886	839	....
145	File History of the Bell & Tainter Patent No. 341,214 of May 4, 1886	839	....
146-A, 146-B	Two Decisions of Supreme Court of Germany, Referred to by Witness Mueller	770	1712

Ex. No.	Description	Offered Vol. II Page	Printed Vol. V Page
147	File History of the Underhill Patent No. 995,390, Granted June 13, 1911	840	....
148	Sketch of the British Pederson Patent No. 115,942, Referred to by Witness Waterman—Marked Exhibit No. 72	840	1715
149	Tabulation Re Weight, Moment of Inertia, Revolutions Per Minute and Kinetic Energy of Flywheels of PS1 and PS16 Machines, Powers Projector and Ernemann Projector	841	1717
150	List of United States, Canadian and German Patents of Vogt, Massolle and Engl	842	1725
151	Affidavit of Carl W. Mittman of Smithsonian Institute, of June 26, 1933, With Respect to Photographs of Berliner Gramophone With Clark's Improvement	842	1737
152	Affidavit of Carl W. Mittman With Respect to Berliner Gramophone and Bell & Tainter Machines	843	1745
153	Affidavit of Carl W. Mittman, Containing Description of Record Strip of Bell & Tainter Machine	844	1747
154-A, 154-B	Records Introduced Under Capps Stipulation, Relating to Lightweight Records Made by Columbia Phonograph Co. in 1906 (Physical)	846	....
155	Edison Triumph Machine Identified by Witness Burt (Physical)	853	....
156	Copies of Sheets of Notebook Identified by Witness Engl	959	....
157	File History and Contents of Cawley Patent No. 1,710,677, Granted April 23, 1929	1025	....
158	File History and Contents of Cawley Patent No. 1,825,440	1025	....
159-A to 159-G, Inclusive	Photographs Taken by Defendants of Tri-Ergon Machine Alleged to Represent Figures 3, 4, 5 and 6 of Patent in Suit	1026	1757

PLAINTIFFS' EXHIBIT NO. 1.

May 21, 1929. H. VOGT ET AL 1,713,726

DEVICE FOR PHONOGRAPHS WITH LINEAR PHONOGRAM CARRIERS

Filed March 20, 1922 3 Sheets-Sheet 1

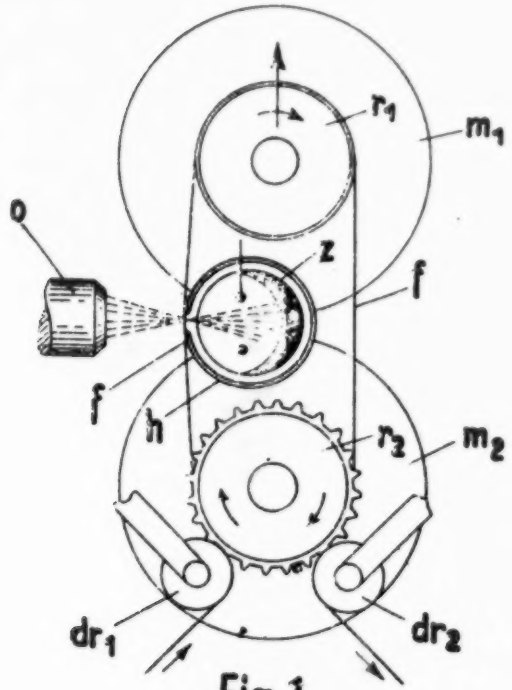


Fig 1

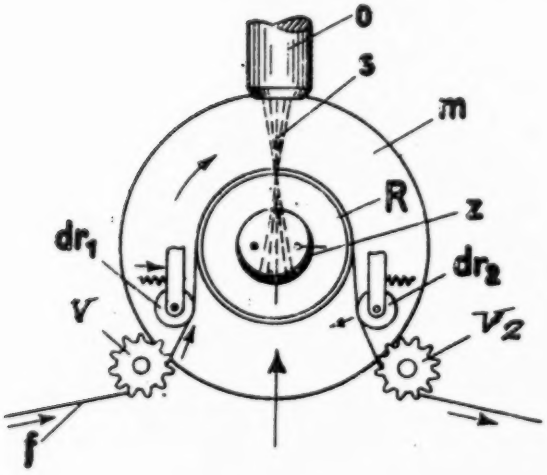


Fig. 2

Inventors
H. Vogt
J. Massolle
J. Engl.

by Munn & Co

Attorneys.

May 21, 1929. H. VOGT ET AL 1,713,726

DEVICE FOR PHONOGRAPHS WITH LINEAR PHONOGRAM CARRIERS

Filed March 20, 1922 3 Sheets-Sheet 2

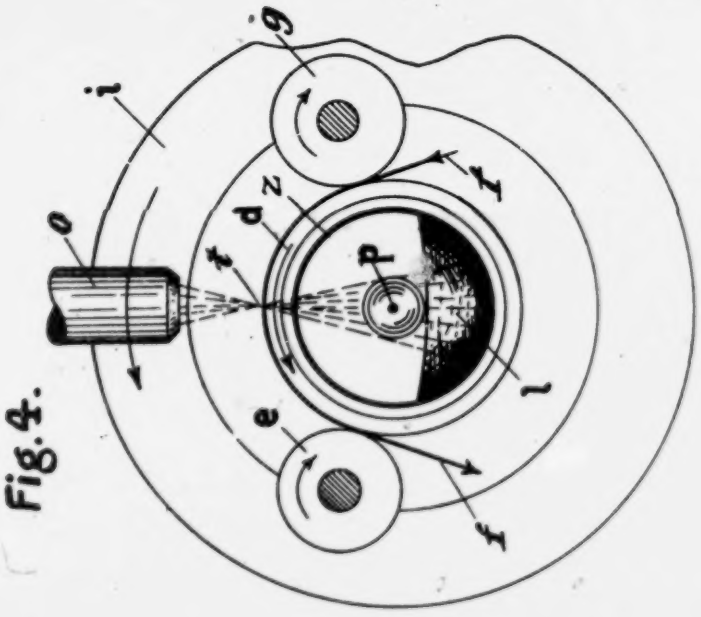


Fig.4.

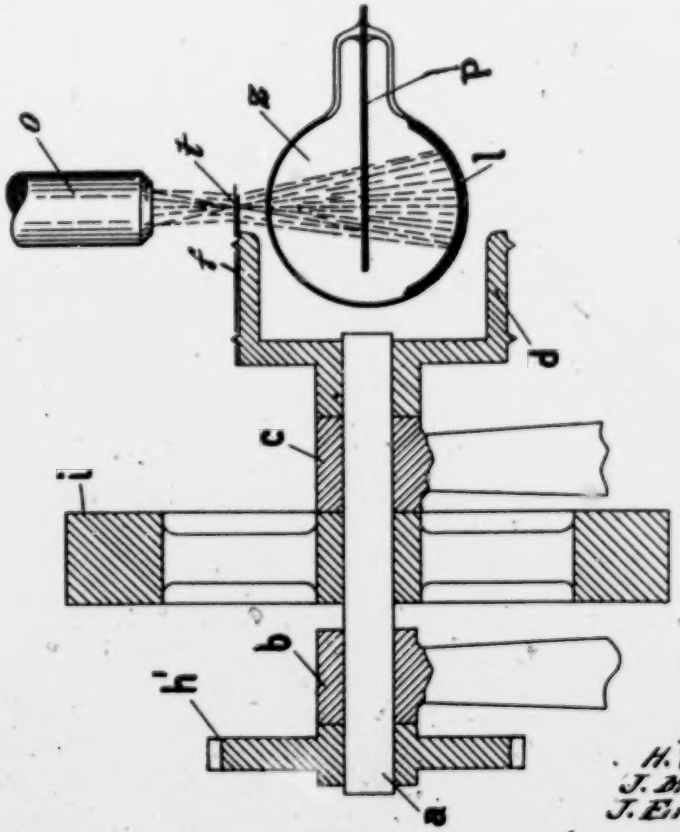


Fig.3

Inventors
H. Vogt
J. Massolle
J. Engl.

by Munn & Co.

Attorneys

May 21, 1929. H. VOGT ET AL 1,713,726

DEVICE FOR PHONOGRAPHS WITH LINEAR PHONOGRAM CARRIERS

Filed March 20, 1922 3 Sheets-Sheet 3

Fig. 6.

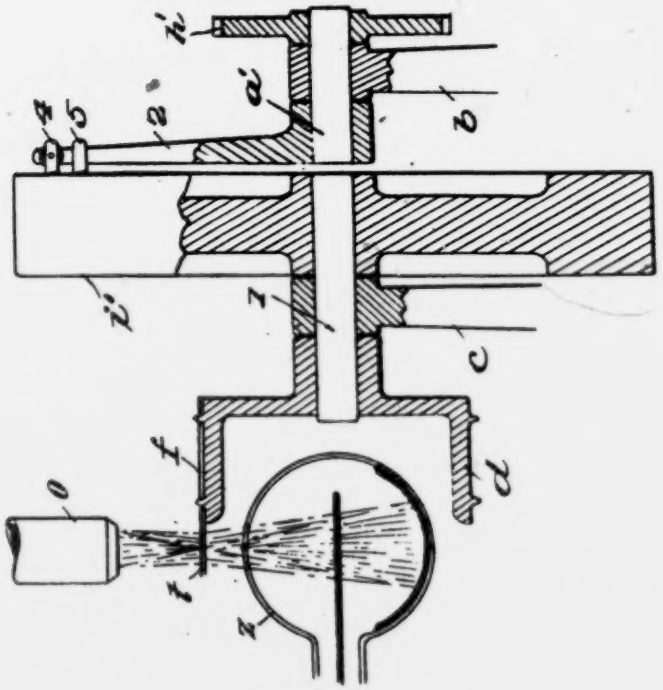
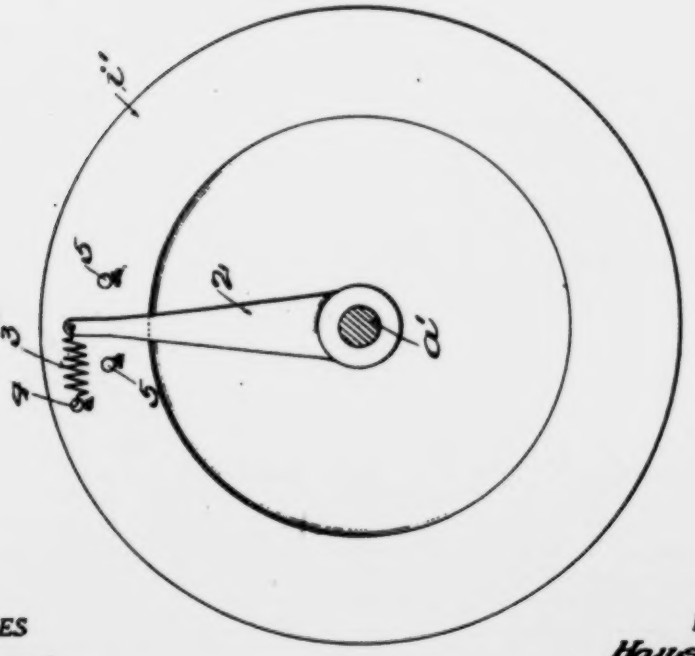


Fig. 5.



WITNESSES

W. A. Williams.

INVENTORS

Hans Vogt
Joseph Massolle.

BY Josef Engl,

ATTORNEYS

UNITED STATES PATENT OFFICE.

HANS VOGT, OF BERLIN-WILMERSDORF AND JOSEPH MASSOLLE AND JOSEF ENGL, OF BERLIN-GRUNEWALD, GERMANY, ASSIGNORS, BY MESNE ASSIGNMENTS, TO WILLIAM FOX, OF WOODSBURGH, NEW YORK.

DEVICE FOR PHONOGRAPHS WITH LINEAR PHONOGRAM CARRIERS.

Application filed March 20, 1922, Serial No. 545,377, and in Germany March 24, 1921.

The recording and the reproduction of sound waves by the use of linear phonogram carriers such as film strips, steel wires, and so forth, can only be effected in absolutely satisfactory manner, even after the removal of all other occurring difficulties, when the speed of the record carrier is uniform both for the receiving and the reproduction, and when in both cases no variations of any kind occur. Especially in the case of musical reproductions is the record extremely sensitive to the slightest variations of speed. Consequently, it has hitherto been usual to provide apparatuses such as phonographs and gramophones with speed regulators. In these apparatuses, however, the problem of the uniform motion does not assume the same importance as in the case of sound recording or reproducing apparatus embodying linear phonogram carriers, such as photographic sound records on film strips or ribbons because with the former the record carrier consists of a cylinder or disc possessing a somewhat considerable momentum when the desired velocity is imparted thereto which equalizes any small irregularities in the motion, such as may be caused, for instance, by the driving mechanism. In the latter case, however, that of phonographs with linear records, such as film strips, the portion of the record which is active at a given moment possesses practically no momentum to be taken into consideration. Irregularities in the motion, such, for instance, as may be caused by the projections, the teeth, the belts, the connecting places, and so forth, or by the friction, at the guiding point (the slot, the magnet, the condenser), become consequently very much more important with these and thus greatly impair the periodicity of the sound recorded.

According to the present invention, this draw-back which attaches to all hitherto known propulsion mechanisms for linear phonogram records is obviated by the arrangement, that the light sound record has given to it at the controlling point the property of a weighty mass. This is attained by the arrangement that the record carrier (a film strip or the like) is firmly pressed against one or more rollers connecting with a heavy rotating mass, so that the record moves in exact conformity with the rollers and the rotating mass.

Also, according to the present invention a dependable and highly efficient optical system is provided for use in conjunction with moving film strips of the above indicated character.

Various further and also various more specific objects, features and advantages will more clearly appear from the detailed description given below taken in connection with the accompanying drawings, which form a part of this specification.

The invention consists in such novel features, arrangements and combinations of parts and methods as may be shown, described and claimed in connection with the embodiments of the invention herein disclosed by way of example only.

Constructional examples of the invention are illustrated in the figures, in which:—

Figure 1 is a side elevation of a linear phonogram carrier.

Figure 2 is a side elevation of a modified form of phonogram carrier.

Figure 3 is a longitudinal section of another form of phonogram carrier.

Figure 4 is an end view of the form of carrier shown in Figure 3.

Figure 5 is a view in elevation of a fly wheel showing an elastic coupling adaptable to the rear side of the fly wheels, the face views of which are shown in various of the other figures.

Figure 6 is a vertical section of the same.

Referring to Fig. 1, partially illustrating sound reproducing apparatus, the phonogram carrier, which in these illustrations is shown as a film strip bearing a photographic sound record, moves over the rollers r', r^2, suitably coupled by gearing or belting, of which rollers preferably the roller r^2 directly driven by the motor is provided with teeth. One or even both rollers are rigidly connected with rotating masses as at m', m^2, which give to the film strip f travelling between them under tension the requisite uniformity of its motion. Between the rollers r', r^2, there is placed preferably in a casing h the light-sensitive cell s sensitive to electric

light, which is influenced by a light ray passing from a light source (not shown), through objective *o*, and then through the film. The rollers or idlers dr', dr^2, press the film against the carrier roller r^2.

Another construction of the invention as shown in Fig. 2, in which the little irregularities of movement often caused by the feeding of the film by the teeth or roller r^2, in the Fig. 1 construction, or which are caused by the mechanical vibrations of the stretches of film between rollers r' and r^2, in the Fig. 1 construction, are avoided.

The film *f* is drawn by the sprocket V to the controlling point *s* and is removed from the controlling point by the roller V^2. Between these feeding sprockets, the film is guided over the periphery of a larger roller R on which it rests closely by friction, even during the turning motion. As the roller is rigidly connected with the rotating mass *m*, or can be constructed so as to be itself the rotating mass, the film moves uniformly on in like manner as the surface of the roller R. For the purpose of pressing the film upon the roller R, and for the equalizing of irregularities of motion, there are provided with spring-supported rollers dr', dr^2. That is, the spring pressed rollers engaging the film at points between the feeding rollers and the fly wheel roller, thus exert resilient pressure against the film to force the film into effective engagement with the fly wheel and thereby at the same time the film is deflected from a straight line position, the extent of such deflection varying slightly with any irregularities in the movement of the film and its resulting tension, with the result that any such irregularities are effectively prevented from being imparted to the film at the point of translation. The light rays required for the illumination or the transmission of light through the film are thrown upon the film in the form of a narrow line by means of the objective *o*. When sound is to be reproduced from the photographic sound record on the film, the light rays pass through the film strip and fall upon the photo cell *z* preferably placed in the interior of roller R. For this purpose, the roller is either partially transparent, made of glass, for example, or the part of the film bearing the sound record projects beyond the non-transparent parts of the roller.

In the hereinbefore described form of execution of the invention the driving of the film sound record is however not effected directly at the point of projection but in front or behind the same. The driving point of the film can however, in a further development of the invention, be arranged directly at the point at which light is projected through the record. The driving member can, in this case, be constructed in such a manner that the engaging and disengaging, of the feeding teeth of the film-feeding sprocket with the perforations of the film, will not affect the speed of the film at the projection point, i. e., at the point at which light falls upon the film in recording, or at which it passes through the film in reproducing.

Figures 3 and 4 show this form of construction by way of example. The shaft *a* journalled at *b* and *c*, carries at one end the feeding-cylinder *d* which has the customary teeth designed to engage with the perforations of the film. The film *f* is in contact with one part of the circumference of this cylinder, the length of this part corresponding with the distance between the pressure rollers *e* and *g*, Fig. 4. The driving member *h'* such as a gear for example, and also the fly wheel *i*, are keyed upon this shaft and designed to communicate to the shaft and consequently to the cylinder *d*, a uniform revolving speed. The film will consequently move also with uniform speed, for instance in the direction *g*—*e*. These rollers *e*—*g* press the film strip firmly against the cylinder *d* so that it lies, without possibility of being shifted, upon the entire peripheral length of cylinder *d* from *g* to *e*, because of the feed teeth of cylinder *d* engaging with the perforations of the film. The engagement and disengagement of the feed teeth on cylinder *d*, with the perforations of the film, takes place under the pressure of the rollers *g* and *e*, Fig. 4, so that vibrations or jerky motions of the film band, due to such tooth engagement or disengagement, no longer make themselves felt at the point of light projection through the same. The free ends *f*—*f* of the film band are preferably guided by rollers (not shown) for preliminary winding up in the manner well known in picture cinematography, so that they form a loop.

It will be understood that the invention is intended particularly for use in connection with transparent film records, on which sound is recorded photographically, by causing acoustically modulated light to act upon the film at the control point. Also that, in reproducing, light passes through the sound record on the film at the control point, and falls upon the photo-cell *z* to set up currents corresponding, in frequency variations, to the sound record through which the light has passed. Also, that the film may pass from a supply reel on which it is wound, at the starting end, to a reel on which it is progressively wound, at the final end, as is usual in cinematography. Further, that the film contemplated may be a talking moving picture film, containing pictures in addition to the sound record. Such a record must be fed intermittently past the point at which the pictures are re-

corded on the film, or at which the projection light shines through the pictures in reproducing. In addition there is need of feeding the film uniformly past the point at which the sound is recorded or reproduced. For such film the loop referred to is preferably formed, between the point of intermittent feed for picture recording or projection, and the point of uniform motion for sound recording or reproducing, the production of such loops in the film being common in cinematography.

For recording purposes a solid cylinder or roller may be employed in place of the roller *d* upon which the full width of the film strip will bear, since in recording the acoustically modulated light which is to be recorded need not pass through the film but only need act upon the sensitized upper surface thereof.

For reproducing purposes, a specially constructed roller *d* is required. This is for the reason that the light from the projection light source, condensed by the lens *o* to a narrow line at the surface of the film, must pass through the film and fall upon a light-sensitive element, for instance the cell *z* with the cathode *l* and anode *p*. The cylinder or roller *d* in Figure 3 shows a form of construction by way of example in which the part of the film which carries the sound record projects beyond the edge of the cylinder. The light collected by the object glass *o* to a narrow line, comes from a suitable known means or source of light projection so arranged, as indicated for example by the dotted lines in Figs. 3 and 4, that the converged narrow line of light is substantially focused or impinges upon the area of translation *t* on the film as a line running transversely of the direction of movement of the film.

Certain features of this type of optical system are also disclosed in our Patent No. 1,590,185, issued June 29, 1926, application for which was filed on April 4, 1921, and the claims of which patent relate to divisional subject matter.

The sound record as indicated in Fig. 3 may be located at the outer side of one row of perforations in the film. The sound record markings can, however, if desired, be located between the two rows of perforations in the film, in which case only one row of perforations would be utilized for feeding the film, these perforations being engaged by the teeth on roller *d* nearest to the center of cell *z*. In this case the sound record portions of the film would still overhang the edge of roller *d*, the far overhanging edge of the film, moving along either without a special guidance or running over a roller with or without feeding teeth, which roller may be an idler or may be specially driven, as desired.

Another feature may advantageously be incorporated in the invention. If the driving shaft of the tone-film revolves with a low number of revolutions and if a rigid drive is used, the circumferential speed of fly wheels which can be practically utilized, will, under certain conditions, not be sufficient for compensating the speed fluctuations.

According to the invention the driving of the fly wheel axle is therefore effected with the aid of an elastic coupling, for instance a spring. This spring can be very feeble as, at constant speed, it has to overcome only the losses from friction of the driven part. As however, at the starting and stopping of the driving mechanism, the inertia of the fly wheel has to be overcome, it is advantageous to limit the play of the spring in either direction by a fixed stop.

Figures 5 and 6 show such a form of execution by way of example. The axle *l* of the wheel with the rotating mass *i'* is separate from the driving shaft *a'*. Upon the latter a lever 2 is arranged which drives the rotating mass through the intermediary of the spring 3 and of the stud 4 fixed to the fly wheel. The studs 5 which are also fixed on the fly wheel limit the stroke of the lever 2 at the starting and at the stopping so that the spring 3 is protected against excessive tension and against jumping out of position.

While the invention has been described in detail with respect to certain particular preferred examples which give satisfactory results, it will be understood by those skilled in the art after understanding the invention that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended therefore in the appended claims to cover all such changes and modifications.

We claim:—

1. In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of means for supporting and progressing the elongated carrier from one point to another point, and past an intermediate point at which the record is made on the carrier in recording or from which the record is taken from the carrier in reproducing, including a cylinder over a portion of the periphery of which the carrier passes adjacent to said intermediate point, a fly-wheel associated with said cylinder, and means for rotating said cylinder, under control of said fly-wheel, at uniform speed.

2. In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of means for supporting and progressing the elongated carrier from one point to another point, and past an interme-

diate point at which the record is made on the carrier in recording or from which the record is taken from the carrier in reproducing, including a cylinder over a portion of the periphery of which the carrier passes adjacent to said intermediate point, a fly-wheel associated with and imparting uniform rotational movement to said cylinder, a driving member, and connections for driving said fly-wheel and cylinder from said driving member including a resilient device for absorbing irregularities of speed in said driving member.

3. In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of a cylinder, a fly-wheel associated therewith, means for rotating said cylinder at uniform speed under control of said fly-wheel, means for feeding the carrier upon said cylinder at one point and off therefrom at another point and causing it to adhere closely thereto without slippage between said points, and means, between which and the record carrier acoustically modulated energy is transferred, as the carrier moves past the same, coacting with the carrier when at a position on said cylinder intermediate said two first named points.

4. In phonographic apparatus in which the sound record is photographically formed on a film ribbon of inconsiderable mass, the combination of a cylinder, a fly-wheel associated therewith, means for rotating said cylinder at uniform speed under control of said fly-wheel, means for feeding a record film ribbon upon said cylinder at one point and off therefrom at another point and causing it to adhere closely thereto without slippage between said points, and means for directing light upon the record film ribbon when at a position on said cylinder intermediate said two first named points.

5. In phonographic apparatus in which the sound record is formed on an elongated ribbon of inconsiderable mass, having feeding perforations therein, the combination of means for supporting and progressing the record ribbon from one point to another point and past an intermediate point at which the record is made on the ribbon in recording or from which the record is taken from the ribbon in reproducing, including a toothed cylinder over a portion of which the ribbon passes adjacent to said intermediate point, the teeth of said cylinder engaging the perforations of the ribbon, a fly-wheel associated with said cylinder, and means for rotating said cylinder, under control of said fly-wheel at uniform speed.

6. In phonographic apparatus in which the sound record is formed on an elongated ribbon of inconsiderable mass, having feeding perforations therein, the combination of means for supporting and progressing the record ribbon from one point to another point and past an intermediate point at which the record is made on the ribbon in recording or from which the record is taken from the ribbon in reproducing, including a cylinder for supporting the record at said intermediate point, a fly-wheel associated with said cylinder for causing uniform motion to be imparted to said cylinder, toothed means engaging the perforations of the ribbon for feeding the latter over the cylinder, and means contacting with the ribbon to prevent vibration thereof when said toothed means are engaging or disengaging the perforations of the ribbon.

7. In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of means for supporting and progressing the elongated carrier from one point to another point, and past an intermediate point at which the record is made on the carrier in recording or from which the record is taken from the carrier in reproducing, including a cylinder over a portion of the periphery of which the carrier passes adjacent to said intermediate point, a fly-wheel, a shaft on which said cylinder and fly-wheel are both secured, a driving member coaxial with said shaft, a resilient connection between said driving member and fly-wheel, and stop means for limiting the amount of yielding of said resilient connection.

8. In phonographic apparatus in which the sound record is photographically formed on a film of ribbon of inconsiderable mass, the combination of a cylinder, a fly-wheel therewith, means for rotating said cylinder at uniform speed under control of said fly-wheel, means for feeding a record film onto said cylinder at one point and off therefrom at another point and causing the film to adhere closely to the cylinder without slippage between said points, said film record being arranged to overhang one end of the cylinder, a photo-cell positioned inwardly of the overhanging position of the film, and means for directing light through said overhanging portion onto said photo-cell.

9. The method of translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound, which comprises flexing the film arcuately longitudinally at the point of translation and rapidly and uniformly moving the film in a circumferential direction past said point.

10. An apparatus for translating sound vibrations representative of speech, music or the like, to or from a film record by the use of light varied in accordance with the sound, which comprises means for imparting to the film a rapid and uniform motion longitudinally of the film and for retaining the

moving film under tension at the area of translation, a source of light projection for providing a line of said light in fixed position, and an objective lens in the neighborhood of said area of translation on the film but spaced therefrom for collecting said projected light and directing the same as a converged narrow line impinging upon said area of translation transversely of the direction of movement of the film.

11. An apparatus for translating sound vibrations representative of speech, music or the like, to or from a film record by the use of a line of light varied in accordance with the sound, which comprises means for imparting to the film a rapid and uniform motion longitudinally of the film, a source of light projection for providing said light, and an objective lens in the neighborhood of the area of translation on the film but spaced therefrom for collecting said projected light and directing the same as a converging narrow line of light impinging directly on to the film at a point in the neighborhood of the focal point of said lens.

12. An apparatus for reproducing speech, music or the like sounds from vibrations recorded on a film, comprising a photoelectric cell, means for imparting to the film a rapid and uniform motion longitudinally of the film past said cell, a source of light projection for providing a line of light in fixed position, and an objective lens in the neighborhood of the area of translation on the film but spaced therefrom for collecting said projected light and directing the same as a converged narrow line extending transversely of the direction of movement of the film and passing through the area of translation on the film and to said cell.

13. An apparatus for reproducing speech, music or the like sounds from vibrations recorded on a film, by the use of a line of light varied in accordance with the sound, comprising a photoelectric cell, means for imparting to the film a rapid and uniform motion longitudinally of the film past said cell, a source of light projection for providing said light, and an objective lens in the path of said light and spaced from the film for directing said light as a converging narrow line impinging on the film at a point in the region of the focal point of said lens, said light passing through the film and on to said cell, the space between said lens and the film being free of obstructions to said light.

14. In combination, optical means for translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound, a constant speed film feeding mechanism, comprising a continuously rotating feeding roller, a fly wheel, a roller over which the film passes and which roller is operatively connected to said fly wheel, and means to compensate for variations in the motion of the film arising from small irregularities in the motion of the film as fed by said feeding roller.

15. In combination, optical means for translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound, a constant speed film feeding mechanism, comprising a continuously rotating feeding roller, a fly wheel, a roller over which the film passes and which roller is operatively connected to said fly wheel, means to compensate for variations in the motion of the film arising from small irregularities in the motion of the film as fed by said feeding roller, said compensating means including a spring pressed roller engaging the film at a point between said feeding roller and said fly wheel roller with a resilient pressure causing the film to be deflected a variable amount in passing over said spring pressed roller, the extent of such deflection varying with said irregularities of motion.

16. In combination, optical means for translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound, a constant speed film feeding mechanism, comprising a continuously rotating feeding roller, a fly wheel, a roller over which the film passes and which roller is operatively connected to said fly wheel, means to compensate for variations in the motion of the film arising from small irregularities in the motion of the film as fed by said feeding roller, said compensating means including a member yieldingly pressing against the film at a point between said feeding roller and said fly wheel roller to variably deflect the film from a straight line path at such point.

17. In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of means for supporting and progressing the elongated carrier from one point to another point, and past an intermediate point at which the record is made on the carrier in recording or from which the record is taken from the carrier in reproducing, including a cylinder over a portion of the periphery of which the carrier passes adjacent to said intermediate point, a fly wheel operatively associated with said cylinder, said carrier progressing means operating to advance the carrier past said intermediate point at uniform speed under the control of said fly wheel.

18. The method of translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound, comprising rapidly advancing the film past the point of translation, and

subjecting the motion of the film in passing said point, to the control of inertia means to effectively eliminate irregularities in the movement of the film.

19. The method according to claim 18, and in which the film is yieldingly pressed into contact with a supporting area immediately adjacent the point of translation, such pressure cooperating with the inertia control in the elimination of irregularities in the film motion.

HANS VOGT.
JOSEPH MASSOLLE.
DR. JOSEF ENGL.

CERTIFICATE OF CORRECTION.

Patent No. 1,713,726. Granted May 21, 1929, to

HANS VOGT ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, line 6, for the word "as" read "is"; line 9, for "or" read "on"; line 16, for "roller" read "sprocket", and line 28, for "with" read "the"; page 4, line 113, claim 8, for "position" read "portion"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of July, A. D. 1929.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE

To all persons to whom these presents shall come, Greeting:

THIS IS TO CERTIFY that the annexed is a true copy from the records of this office of the File Wrapper, Contents and Drawings, in the matter of the

Letters Patent of

Hans Vogt, Joseph Massolle and Josef Engl, Assignors, by Mesne Assignments, to William Fox,

Number 1,713,726, Granted May 21, 1929,

for

Improvement in Devices for Phonographs with Linear Phonogram Carriers.

U. S. DISTRICT COURT
M. D. PENN.
COMPL. EX. 1

IN TESTIMONY WHEREOF I have hereunto set my hand and caused the seal of the Patent Office to be affixed, at the City of Washington, this eighteenth day of February, in the year of our Lord one thousand nine hundred and thirty-three and of the Independence of the United States of America the one hundred and fifty-seventh.

ATTEST:

Chief of Division.

Thomas E. Robertson
Commissioner of Patents.

12

845377

1,012

DIV. 235 DIV 6 PATENT No. 1713726

MAY 21 1929

Hans Vest, [illegible] Wassollo and Ernst Engel, Zadora to Lee Engel, Limited, Biel, Switzerland. (Ass'ts)
Welsh Fox of Woodstock, N. Y.

of Berlin-Nelmersdorf and Berlin-Grunewald,

Gerrymt
Device for Phonographs With Lines
Phonogram Carriers.

ORIGINAL

Petition	Mar. 20	1922
Admitt	" "	1922
Spr. Specification	" "	1922
Drawing	" "	1922
Add. Drawing	May "	1922
Finally Rej.		192
Final Rej.	15. Mar. 20	1922
Appl. filed comp.	Mar. 20	1922

Certificate of Correction RENEWED

July 2, 1929	192
	192
	192
	192
	192
	192
	192
	192
Ex. Div.	
	192
	192
	192

Examined and Passed for Issue Nov. 23, 1929
Ex. Div. 5
Notice of Allowance Nov. 23, 1929
Final Fee Apr. 20, 1929
Patented MAY 21 1929
Attorney Wood & Co., 625 of Lib. N.Y. City.
Associate Attorney Ward and [illegible], 233 Broadway, N.Y.

No. of Claims Allowed 1 Print Claims 8415 in O.G. Cl. 274/5
Title as Allowed A Device for Phonographs With Lines Phonogram Carriers

$15 RECD MAR 30 1922 U.S.PAT.OFFIC

3295

PETITION.

TO THE COMMISSIONER OF PATENTS:

Your petitioners, HANS VOGT, resident of Berlin-Wilmersdorf, Germany, JOSEPH MASSOLLE and JOSEF ENGL, residents of Berlin-Grunewald, Germany, citizens of the German Republic, whose post-office addresses are, HANS VOGT, 49 Babelsbergerstrasse, Berlin-Wilmersdorf, Germany, JOSEPF MASSOLLE, 60 Cunostrasse, Berlin-Grunewald, Germany JOSEF ENGL, 53 Hohenzollerndamm, Berlin-Grunewald, Germa pray that Letters Patent may be granted to them for A DEVICE FOR PHONOGRAPHS WITH LINEAR PHONOGRAM CARRIERS as set forth in the annexed specification, and they hereby appoint CHARLES A. MUNN, and ORSON D. MUNN, constituting the ~~Munn, Munn & Co., 233 Broadway, New York~~ firm agents of Munn & Co. of the cities of New York, N. Y. and Washington, D. C. or accredited their Attorneys, with full power of substitution and revocation, to prosecute the above entitled application to make alterations and amendments therein, to receive the patent, to transact all business in the Patent Office connected therewith, and to sign their name to the drawings.

Signed at Berlin, Germany, by the said Hans Vogt this 1st day of March 1922.

Hans Vogt

Signed at Berlin, Germany by the said Joseph Massolle this 1st day of March 1922

Joseph Massolle

Signed at Berlin, Germany by the said Josef Engl, this 1st day of March 1922

Dr. Josef Engl

545377-D

TO ALL WHOM IT MAY CONCERN:

Be it known that we, HANS VOGT, JOSEPH MASSOLLE and JOSEF ENGL, citizens of the German Republic, and residents respectively the first of Berlin-Wilmersdorf, the second and third of Berlin-Grunewald, Germany, have invented a new and improved

DEVICE FOR PHONOGRAPHS WITH LINEAR PHONOGRAM CARRIERS

of which the following is a full, clear and exact description.

The recording and the reproduction of sound waves by the use of linear phonogram carriers such as film strips, steel wires, and so forth, can only ~~then~~ be effected in absolutely satisfactory manner, even after the removal of all other occurring difficulties, when the speed of the ~~tone~~ record carrier is uniform both for the receiving and the reproduction, and when in both cases no variations of any kind occur. Especially in the case of musical reproductions is the record extremely sensitive to the slightest variations of speed. Consequently, it has hitherto been usual to provide apparatuses such as phonographs and gramophones with speed regulators. In these apparatuses, however, the problem of the uniform motion does not assume the same importance as in the case of ~~phonographs with~~ sound recording or reproducing apparatus such as photographic sound records on film strips linear phonogram carriers, because with the former the ~~tone~~ record carrier consists of a roller or disc ~~or cylinder~~ possessing a somewhat considerable ~~mass~~ momentum which equalizes any small irregularities in the motion, such as may be caused, for instance, by the driving mechanism. In the latter case, however, that of phonographs with linear records, such as film strips ~~the operative portion of the~~ record which is active at a given moment possesses practically no momentum to be taken into consideration. Irregularities in the motion, such, for instance, as may be caused by the projections, the teeth, the belts, the connecting places, and so forth, or by the friction at the guiding point (the slot, the magnet, the condenser), become conse-

quently very much more important with these greatly and thus impair the periodicity of the sound recorded by considerable amounts.

According to the present invention, this drawback which attaches to all hitherto known propulsion mechanisms for linear phonogram records is obviated by the arrangement, that the light sound record has given to it at the controlling point the property of a weighty mass. This is attained by the arrangement that the record carrier (a film strip or the like) is firmly pressed against one or more rollers connecting with a heavy rotating mass, so that the record moves in exact conformity with the rollers and the rotating mass.

Insert D'

(17)

Constructional examples of the invention are illustrated in the Figures,

Insert A'

The phonogram carrier, which in these illustrations is shown as a film strip, moves over the rollers r^1, r^2, suitably coupled by gearing or belting, of which rollers preferably the roller r^2 directly driven by the motor is provided with teeth. One or even both rollers are rigidly connected with rotating masses as at m^1, m^2, which give to the film strip f travelling between them under tension the requisite uniformity of its motion. Between the rollers r^1, r^2, there is placed preferably facing the light-sensitive cell z, which is influenced by a light ray passing from a light source (not shown) through the right objective o and out of it and over the film. The rollers dr^1, dr^2, or idlers press the film against the carrier roller r^2.

Another construction of the invention, as shown in Fig. 2, in which the little irregularities of movement often caused by the teeth of the film or roller 3 are avoided, is shown in Figure 2.

The film f is drawn by the sprocket V to the controlling point s and is removed from the controlling point by the sprocket V'. Between these leading sprockets, transporting rollers, the film is guided over the periphery of a larger roller R on which it rests closely by adhesion, even during the turning motion. As the roller is rigidly connected with the rotating mass m, or can be constructed so as to be itself the rotating mass, the film moves uniformly on in like manner as the surface of the roller R. For the purpose of pressing the film upon the roller R, and for the equalizing of irregularities of motion, there are provided the spring-supported rollers dr', dr². The light rays required for the illumination or the transmission of light through the film are thrown upon the film in the form of a narrow line by means of the objective o. The light rays pass through the film strip and fall upon the photo cell z preferably placed in the interior of roller R. For this purpose, the roller is either partially transparent, made of glass, for example, or the part of the film bearing the sound record projects beyond the non-transparent parts of the roller.

In the hereinbefore described form of execution of the invention the driving of the ~~tone band~~ sound record is however not effected directly at the point of projection but in front or behind the same. The driving point of the ~~tone band~~ film can however, in a further development of the invention, be arranged directly at the point of projection. The driving member can, in this case, be constructed in such a manner that ~~the coming in gear and the getting out of gear of the feeding teeth in the perforations remains without reaction on the speed of the film band at the point of projection.~~

Fig. 3 shows this form of construction by way of example. The shaft a journalled at b and c, carries at one end the feed-cylinder d which has ~~usual~~ teeth designed to engage with the perforations of the ~~tone-band~~ film. The film f is in contact with one part of the circumference of this cylinder, the length of this part corresponding with the distance between the ~~pressing pulleys~~ pressure rollers e and g, the driving ~~disk~~ wheel h for which a toothed wheel or any other convenient means can be substituted, and further the fly wheel i, are keyed upon this shaft and designed to communicate to the shaft and consequently to the cylinder d, a uniform revolving speed. The ~~tone band~~ film will consequently move also with uniform speed, for instance in the direction f-e. These ~~pulleys~~ rollers e-g ~~press the band strongly~~ firmly against the cylinder d so that it is securely guided upon the entire length from f to e owing to the feeding teeth engaging with

the perforations. The throwing in gear and out of gear of the feeding teeth is effected by the pressure of the pulleys f and g so that vibrations of the film band at the point of projection do no longer occur. The free ends g-g of the film band are preferably guided by the rollers for preliminary winding up in the manner well known from cinematography so that they form a loop. For recording purposes, if the rythmically controlled light which has to be recorded needs expose the tone band only upon the coated surface, a solid cylinder d can be used, upon which the film band bears with its entire width.

For reproducing purposes, when the light, collected by the object-glass h to a narrow line coming from the source of light-projection traverses the film in order to get at light-sensitive element, for instance the cell k with the cathode l and anode m, a specially constructed cylinder is required, d or in figure 3 shows a form of construction by way of example in which the part of the band which carries the tone-signs projects over the edge of the cylinder. The tone signs can be utilised also between the two rows of perforations, as only one row of perforations is used for conveying, the other side of the tone band moving along either without a special guiding arrangement or with the aid of a wheel with or without feeding teeth, which is specially driven, or not as desired. If the driving shaft of the tone film revolves merely with a low number of revolutions and if a rigid drive is used, the circumferential speed of fly

wheels which can be practically ~~still~~ utilized, will, under certain conditions, not be sufficient for compensating the speed fluctuations.

According to the invention the driving of the fly wheel axle is therefore effected with the aid of an elastic coupling, for instance a spring. This spring can be very feeble as, at constant speed, it has to overcome only the losses from friction of the ~~driving~~ part. As however, at the starting and ~~running out~~ of the driving gear, the inertia of the fly wheel has to be overcome, it is advantageous to limit the play of the spring in either direction by a fixed stop.

We claim:-

1.- An arrangement for phonography with linear phonogram carrier characterized in that constant speed is imparted to the phonogram carrier at the point of recording or at the governing point by means of a heavy mass moving with the same, in providing the recording- or governing point (s) of the phonogram carrier (f) between the two cylinders (r' and r^2) (fig. 1) having each a fly wheel (m' or $m2$), if a cylinder (R) with fly wheel (m) is used, upon the circumference (fig. 2).

2.- A driving device for tone bands as claimed in claim 1 characterized in that the toothed cylinders which feed the tone band act directly at the projection-point of the tone band.

3.- A driving device as claimed in claim 2 characterized in that, for reproducing purposes, the part of the film bands which carries the tone-records

projects over the edge of the toothed cylinder so that the bundle of light-rays can get without impedement to the light-electric element.

4. Drive for tone films as claimed in claim 1 or 2 characterized by a drive with electric coupling

5. Form of construction of the drive as claimed in claim 4 characterized by the limiting of the coupling (spring) at either side by fixed stops.

Paul Vogt

Joseph Carroll

Dr. Joseph Engl

Witnesses:

Bruno Schramm

John W. Berkley

3304

O A T H

.....
) ss:
.....)

.....
) ss:
.....)

.....
Consulate General of the United States of America)
City of BERLIN Empire of Germany) ss:
.....)

HANS VOGT, resident of Berlin-Wilmersdorf, Germany, JOSEPH MASSOLLE and JOSEF ENGL, residents of Berlin-Grunewald, Germany, the above named petitioners being duly and severally sworn depose and say: that they are citizens of the German Republic; that they verily believe themselves to be the original, first and joint inventors of the DEVICE FOR PHONOGRAPHS WITH LINEAR PHONOGRAM CARRIERS, described and claimed in the annexed specification, that they do not know and do not believe that the same was ever known or used before their invention or discovery thereof or patented or described in any printed publication in any country before their invention or discovery thereof, or more than two years prior to the above entitled application; or in public use or on sale in the United States for more than two years prior to this application; that said invention has not been patented in any country foreign to the United States on an application filed by them or their legal representatives or assigns more

3305

than twelve months prior to the above-entitled application; and that no application for patent on said improvement has been filed by them or their representatives or assigns in any country foreign to the United States, except as follows:

Germany, March 24, 1921 (V. 16360 IX/42g)
Germany, April 9, 1921 (V. 16430 VI/57a2)
Germany, January 23, 1922 (V. 17149 IX/42g)

.....Haus Vogt.....

~~Sworn to and subscribed before me by the said HANS VOGT, this — day of~~

Joseph Mascolle

Dr. Josef Engl

Sworn to and subscribed before me this 21st day of March 1922

C W Turrell

Vice-Consul of the United States of America....

~~Sworn to and subscribed before me by the said Joseph Mascolle, this day of~~

.....

~~Sworn to and subscribed before me by the said JOSEF ENGL, this day of~~

24

Div. 23 Room 217

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name.

Paper No. 2

All communications concerning this application should give the serial number, date of filing, title of invention, and name of the applicant.

B/H

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON June 6, 1922

Munn & Co.,

Washington, D. C.

Please find below a communication from the EXAMINER in charge of the application of

Hans Vogt, et al, Mar. 20, 1922, Ser. No. 545,377, Device for Phonographs With Linear Phonogram Carriers.

Thomas E. Robertson

Commissioner of Patents.

This case has been examined.

The claims are rejected as not conforming to the form required by U. S. Practice under Sec. 4888 R. S.

On allowance of any claim or upon appeal, revision as to form may be required (Order 2749).

The legend (Fig. 3) is applied to two different views. Objection is made and correction is required.

b

H. W. Emmbrick,

Exr.

545377-(12)

Paper No. 4

a

HES:MK

DIV. 23

IN THE UNITED STATES PATENT OFFICE.

In re application of : 3306

Hans Vogt :

Device for Phonographs with Linear Phonogram Carriers : Room 217

Filed March 20, 1922 : Div. 23

Serial No. 545,377 :

---oooOooo---

Hon. Commissioner of Patents,

Washington, D. C.

S I R:

In response to the Office Letter of June 6, 1922, amend the above entitled application as follows:

Page 2, line 19, correct the spelling of "somewhat".

On page 3, line 16, change the period to a comma and add --in which--

¶ Figure 1 is a side elevation of a linear phonogram carrier.

¶ Figure 2 is a side elevation of a modified form of phonogram carrier.

a1

¶ Figure 3 is a longitudinal section of another form of phonogram carrier.

¶ Figure 4 is an end view of the form of carrier shown in Figure 3.

¶ Figure 5 is a view in elevation of a fly wheel showing an elastic coupling (2)

Insert K'

¶ Figure 6 is a vertical section of the same.--

Same page, line 22, change "toothing" to --teeth-- and change "one" to --One--

---1---

545377-(2)

Page 5, cancel lines 9 to 12 inclusive and substitute therefor the following:-- The feeding teeth of the toothed gear which are meshing with and coming out of mesh with the perforation in the linear phonogram will not affect the speed of the film band at the point or projection of recordation of the record.-- Line 13, change "figure" to --Figures-- Same line, after the numeral "3" insert --and 4-- Line 15, cancel "as". Line 16, cancel "usual". Line 24, correct the spelling of "communicate". Line 28, change "strongly" to --firmly--

Page 6, lines 1 and 2, cancel "the throwing in gear and out of gear" and substitute therefor --the meshing and the coming out of mesh-- Lines 8 to 11, cancel the following "for recording purposes, if the rhythmically controlled line which is to be recorded needs expose the tone band upon the coated surface" and substitute the following --If, for recording purposes, it is necessary only to expose the coated surface of the tone band to the rythmically controlled line-- Line 17, change "a" to --at the-- Line 17, change the letter "i" after "cathode" to --I-- and the letter "m" after "anode" to --p-- Line 22, change "sings" to --signs--

Page 7, after line 12 insert the following paragraph:

#Figures 5 and 6 show such a form of execution by way of example. The axle 1 of the wheel with the rotating mass 1' is separate from the driving shaft a'. Upon the latter a lever 2 is arranged which drives the rotating mass

through the intermediary of the spring 3 and of the stud 4 fixed to the fly wheel. The studs 5 which are also fixed on the fly wheel limit the stroke of the lever 2 at the starting and at the stopping so that the spring 3 is protected against excessive tension and against jumping out of position.

Cancel the claims and substitute therefor the following:

--1. In a phonograph employing linear records, a cylinder for supporting a record at the point of recordation of said record, means for driving the cylinder, and means for causing a uniform motion to be imparted to the cylinder.

2. In a phonograph employing linear records, a cylinder for supporting the record at the point of recordation of the same, means for rotating the cylinder, and a fly wheel in close association with the cylinder and rotatable therewith for causing uniform motion to be imparted to said cylinder.

3. In a phonograph employing linear records, a plurality of cylinders for supporting a record at the point of recordation of the record, means for rotating the cylinders, means for maintaining the record in close contact with the moving cylinders, and means for causing uniform motion to be imparted to the cylinders.

4. In a phonograph employing linear records, a cylinder for supporting the record at the point of recordation of the same, means for rotating the cylinder, and a fly wheel in close association with the cylinder and rotatable therewith for causing uniform motion to be imparted to said cylinder, and toothed means adjacent the point of recor-

tion of the record for feeding the records over the cylinder.

5. In a phonograph employing linear records, a cylinder for supporting the record at the point of recordation of the same, means for rotating the cylinder, and a fly wheel in close association with the cylinder and rotatable therewith for causing uniform motion to be imparted to said cylinder, said cylinder being provided with teeth for feeding the records lineally and directly at the point of recordation of the records.

6. In a phonograph employing linear records, a cylinder for supporting the record at the point of recordation of the same, means for rotating the cylinder, and a fly wheel in close association with the cylinder and rotatable therewith for causing uniform motion to be imparted to said cylinder, toothed means adjacent the point of recordation of the record for feeding the records over the cylinder, and means to prevent vibration of the linear records when the feeding teeth of the toothed means are meshing or coming out of mesh with the linear records.

7. In a phonograph employing linear records, a cylinder for supporting a record at the point of recordation of said record, means for driving the cylinder, and means for causing a uniform motion to be imparted to the cylinder, said driving means for the cylinder being provided with an elastic coupling.

8. In a phonograph employing linear records, a cylinder for supporting a record at the point of recordation of said record, means for driving the cylinder, means for causing a uniform motion to be imparted to the cylinder, said driving means for the cylinder being provided with an

elastic coupling, and fixed stops on opposite sides of the elastic coupling for limiting the movement of said coupling.--

9. In a phonograph employing linear records, a cylinder for supporting a record at the point of recordation of said record and of a length to permit the record to project beyond the end of the cylinder so that light rays may pass through the record without impediment from said cylinder, means for driving the cylinder, and means for causing a uniform motion to be imparted to the cylinder.--

REMARKS.

The specification and claims in this case have been carefully revised to conform to the practice of the Patent Office and it is thought that the claims are now in allowable condition in view of the fact that no references have been cited against them.

Permission is requested to add the new sheet of drawing forwarded herewith, containing two figures which illustrate the flexible coupling described on page 7 and covered by the original claims.

An early issue is accordingly solicited.

Respectfully submitted,

HANS VOGT, ET A L

BY.....Attys.

Washington, D. C.

545377-17

30

Mr. 25 Room 217 — Paper No. 5

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name.

All communications respecting this application should give the serial number, date of filing, name of inventions, and name of the applicant.

DEPARTMENT OF THE INTERIOR

But/S

UNITED STATES PATENT OFFICE

WASHINGTON May 31, 1923

Munn & Co.,
625 F St., N. W.,
Washington, D. C.

PATENT OFFICE MAY 31 1923

Please find below a communication from the EXAMINER in charge of the application of

Hans, Vogt, Joseph Massolle and Josef Engl, Ser. No. 545,377, Mar. 20, 1922, Device for Phonographs With Linear Phonogram Carriers.

Thomas E. Robertson
Commissioner of Patents.

Responsive to amendment of May 25, 1923.

The new drawing submitted with the amendment of May 25, 1923 is not supported by the original disclosure, was not required by the examiner, and is, therefore, returned.

On Fig. 1, members r', r^2 are not the same as r' and r^2 on Fig. 2. The same reference characters must refer to the same elements throughout and correction is required.

On page 7, lines 4-12, the structure referred to here is not shown and is not sufficiently described to permit of illustration. Cancellation of these lines is required.

In the amendment of May 25, 1923, page 1, cancellation of the description of Figs. 5 and 6 is required as involving new matter. Cancellation of the amendment after line 12 of page 7 is required on the ground of new matter.

Claims 1 and 2 and 4-6 are drawn to the showing in Figs. 2 and 3.

Claims3 and 9 are specific to Fig. 1. Division is required under Ex parte Eagle, C. D. 1870, 157.

Claims 7 and 8 are rejected as involving new matter.

5455 77-18

Claims 1-6 and 9 are rejected on the ground that to use a fly wheel on any sort of a rotating part to maintain uniform rotation is a mere mechanical expedient and is not invention.

N J Battan
Ad. Exr.

New drawing returned, 6-2-23.

APPLICATION FILED JUN 7 1923 PATENT OFFICE

DIV. 23

HES:MK

Paper No. 6

IN THE UNITED STATES PATENT OFFICE.

In re application of :

Massole, Engl and Vogt :

Device for Phonographs with Linear Phonogram Carriers : Division 23

Filed March 20, 1922 :

Serial No. 545,377 :

---ooo-ooo---

Hon. Commissioner of Patents,

Washington, D. C.

S I R:

It is requested that the Examiner admit the attached drawing since it discloses the construction of the flexible connection between the drive shaft and the rotating mass 1' and likewise the shaft 1 which drives the phonogram carrier D. Applicant has originally described and claimed this construction and it is requested that this drawing be admitted to illustrate the description at the end of the specification.

Respectfully submitted,

MASSOLE, ENGL AND VOGT

BY.....Attys.

Washington, D. C.

545377-Pa

No. 23 Room 217
Addressed only
The Commissioner of Patents,
Washington, D. C.
and not any official by name.

Paper No. 7
All communications regarding this application should give the serial number, date of filing, name of inventor, and name of the applicant.

DEPARTMENT OF THE INTERIOR

B/8

UNITED STATES PATENT OFFICE

WASHINGTON July 25, 1923.

Munn & Co.,
625 F St., N. W.,
Washington, D. C.

PATENT OFFICE
JUL 25 1923
FILED

Please find below a communication from the EXAMINER in charge of the application of

Hans Vogt, et al, Ser. No. 545,377, March 20, 1922.
Device for Phonographs with Linear Phonogram Carriers.

Thomas E. Robertson
Commissioner of Patents.

Responsive to letter filed June 7, 1923.

The examiner traverses applicant's letter of June 7, 1923.

The description which occurs in lines 4-12 of page 7 is not in sufficient detail without other information to suggest new drawings that have been submitted. The drawings are, therefore, refused entry and the case is awaiting response to the office action of May 31, 1923.

6

H. D. Crowell,

Exr.

U. S. PATENT OFFICE
RECEIVED
MAR 23 1924
DIVISION 23

HES:MK

IN THE UNITED STATES PATENT OFFICE.

In re application of :
Hans Vogt et al :
Device for Recording Sound Waves
Filed March 20, 1922 :
Serial No. 545,377 :

Paper No. 8

Room 217
Div. 23

---oooOooo---

Hon. Commissioner of Patents,
Washington, D. C.

S I R:

In response to the Office Letter of May 31, 1923, amend the above entitled application as follows:

Page 4, line 6, change the letter "r' " to --V--
Line 8, change "r^2" to --V^2--

R E M A R K S.

In a recent interview with the Primary Examiner and Assistant Examiner in charge of this application, it was decided to admit the drawing showing Figures 5 and 6 in view of the proposed amendment in Figures 3 and 6 in which the pulley is changed to a gear. The gear forms a rigid connection between the rotating parts and the construction set forth in Figures 5 and 6 is intended to show the flexible or spring connection between the fly wheel and the drive shaft. Applicant is not specifically claiming any of the elements which were included in this figure to properly set forth the construction but only that much of the device which was original disclosed on page 7 and originally claimed.

Since the objection of the Examiner to Figures 5 and 6 this removes the rejection of claims 7 and 8. The subject matter of these claims was originally set forth in claims 4 and 5 in which a coupling or spring is limited on either side by fixed stops.

A reconsideration of the question of division is requested since it is thought that claims 1 and 2 and 4 to 6 inclusive read on Figure 1. Taking claim 2 as an example, this claim calls for a cylinder for supporting the record at the point of recordation of the same, means for rotating the cylinder and a fly wheel in close association with the cylinder and rotatable therewith for causing uniform motion to be imparted to said cylinder. In Figure 1 a plurality of cylinders are shown, nevertheless a cylinder has called for in claim 1 supports a record at the point of recordation of the same with means shown for rotating the cylinder and a fly wheel in close association with the cylinder and rotatable therewith for causing a uniform motion. Therefore where a plurality of elements are shown in the figures and the claim refers to one of such elements, it is thought that the claim will read directly on the figure. It is therefore contended that claims 1 and 2 and 4 to 6, together with claims 3 and 9 are readable on Figure 1.

The rejection of claims 7 and 8 as involving new matter is incorrect in view of the fact that this matter set forth in these claims was originally disclosed in claims 4 and 5.

A reconsideration of the rejection of claims 1 to 6 and 9 is requested since the use of the fly wheel is something more than a means for maintaining uniform rotation. The fly wheel is employed at a point adjacent the recordation

of the film and at a point where the film is being withdrawn from the moving cylinder so that the rate of propogation of the film is uniform particularly at this point in order to produce a uniform record throughout. The Examiner has not shown such a construction and therefore the claims are thought allowable.

An early issue is accordingly solicited.

Respectfully submitted.

HANS VOGT, ET AL

BY.....Attys.

Washington, D. C.

545877-24

No. 23 217 Room [redacted] 2-699 Paper No. 9

Address only "The Commissioner of Patents, and not any official by name.

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON March 28, 1924

Munn and Co.

625 F St., N. W.

Washington, D. C.

PATENT OFFICE MAR 28 1924 MAILED

Please find below a communication from the EXAMINER in charge of the application of

Hans Vogt et al, Ser. No. 545,377, March 20, 1922.

Device for Phonographs With Linear Phonogram Carriers.

Thomas E. Robertson
Commissioner of Patents.

Responsive to amendment filed March 24, 1924.

No invention is found in producing uniform rotation wherever needed. Claims 1 to 6 and 9 are rejected again for reasons of record. The practice of using governors in talking machines is too well known to require the citation of a reference. The use of a fly wheel is also old, see

Comp. Gen. de Phon. (French), 414,788, Sept. 10, 1910, 274-9, 1 sheet.

This patent incidentally shows a governor.

Claim 7 is rejected on the French patent or on

Kramer, (British) 19667, Aug. 28, 1912, 274-9, 1 sheet, or on [redacted]ines (French), 416,838, Oct. 29, 1910, 274-9, 2 sheets.

Claim 8 is rejected on any of these patents taken with

Wale, 255,220, March 21, 1882, 265-25 or
Moore, 930,605, Aug. 10, 1909, 265-25.

These last patents show torque transmissions. Applicant has not corrected the proposed new sheet of drawings as agreed to at a recent interview with counsel, and the drawing is still awaiting the necessary changes.

H. W. Grosbeck,
Exr.

Paper No. 10

ACCORDED

HES:MK

2nd

IN THE UNITED STATES PATENT OFFICE.

In re application of :

Hans Vogt et al :

Device for Recording Soubd Waves DRAFTING DIVISION

Filed March 20, 1922 :

Serial No. 545,377 :

----oooOooo----

Hon. Commissioner of Patents,

Washington, D. C.

S I R:

The Chief Draftsman is requested to correct the Figures 3 and 6 in accordance with the red ink notations on the attached prints and to charge the cost of the correction, if any, to the account of the attorneys of record.

Respectfully,

HANS VOGT ET AL

BY.....Attys.

Washington, D. C.

Approved

Brittain

4-4-24

545377-26

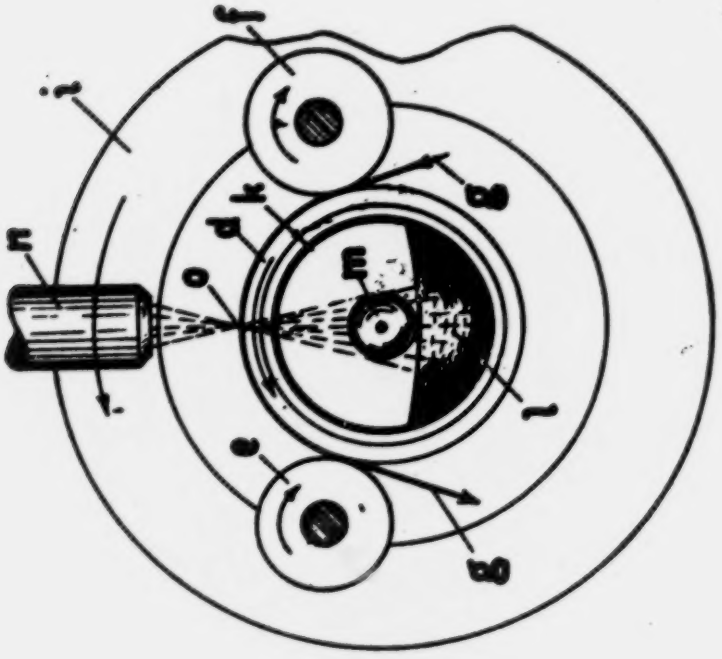


Fig.4.

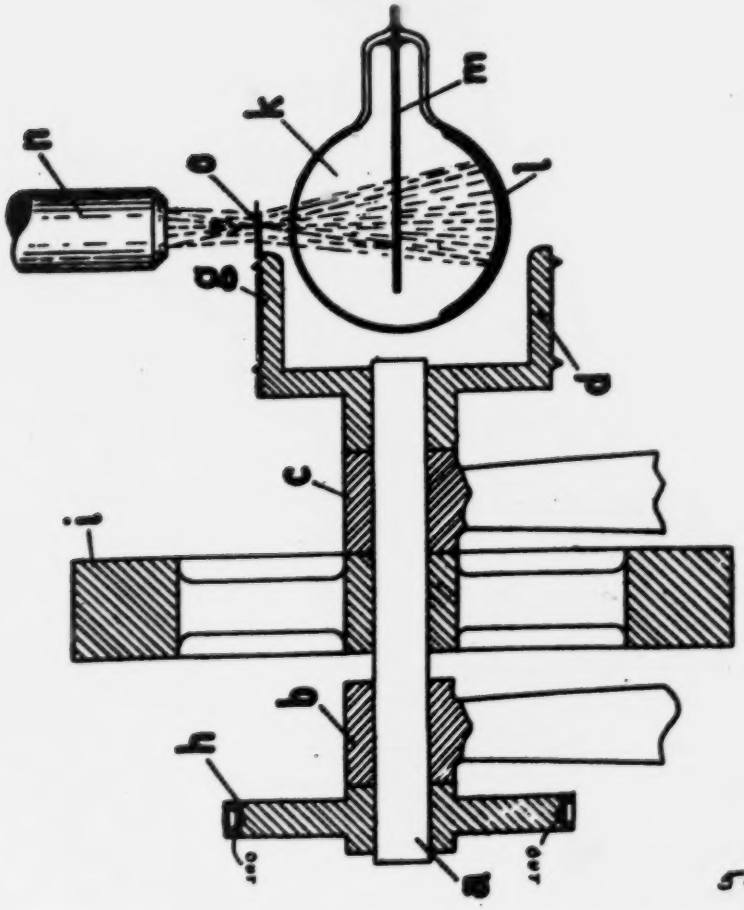


Fig.3

545877-27

Fig. 6.

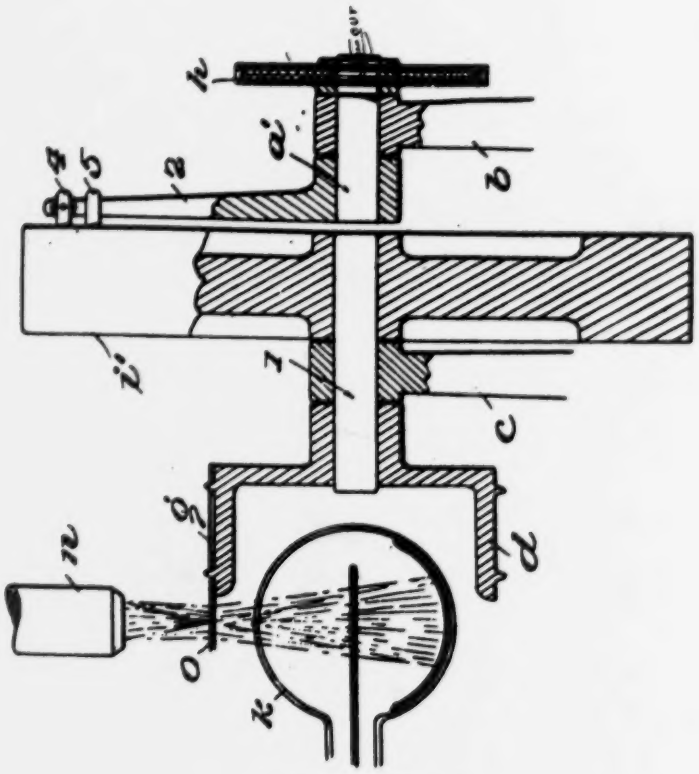
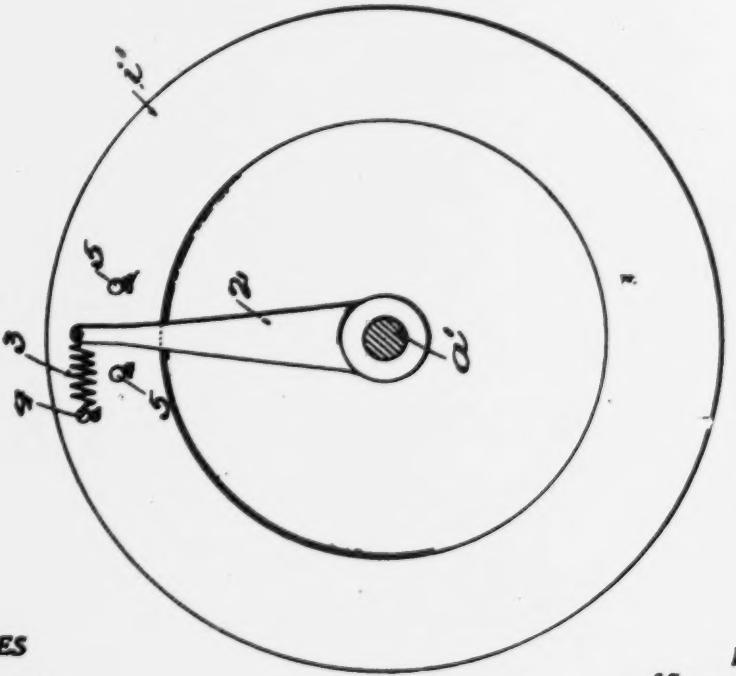


Fig. 5.



WITNESSES

W. A. Williams.

INVENTORS

Hans Vogt
Joseph Massolle
BY Josef Engl.

5W6377-28 ATTORNEYS

545377

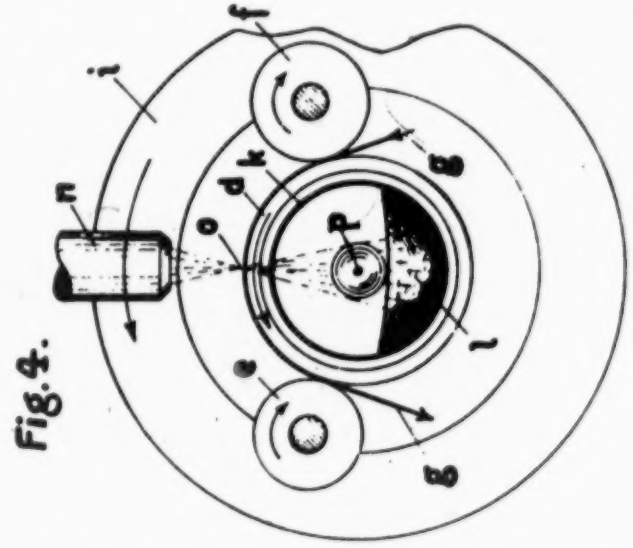


Fig.4.

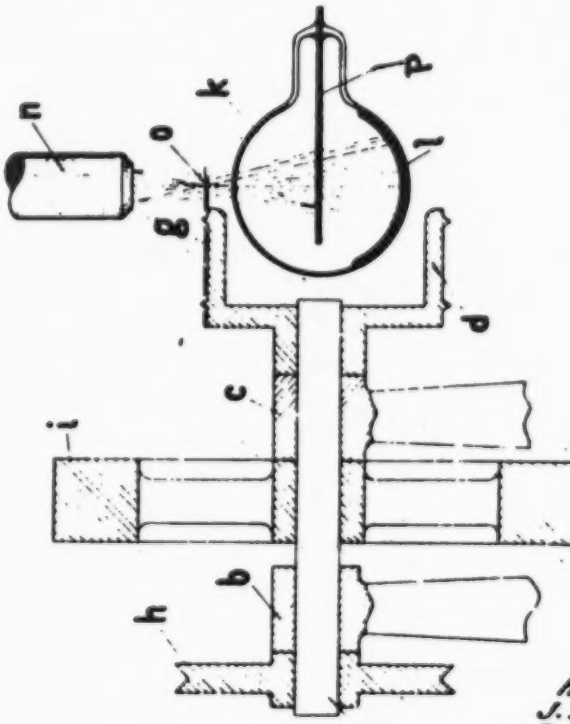


Fig.3

Inventors
H. Vogt
J. Makovelle
J. Pinsl.
by Munn & Co.
Attorneys

Fig. 6.

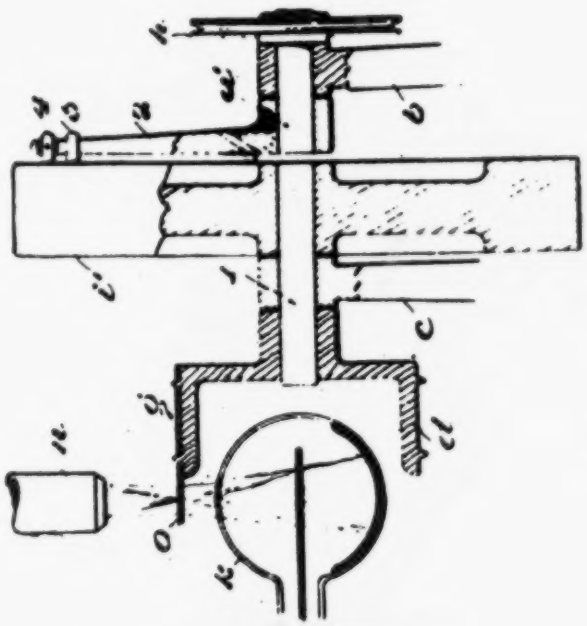
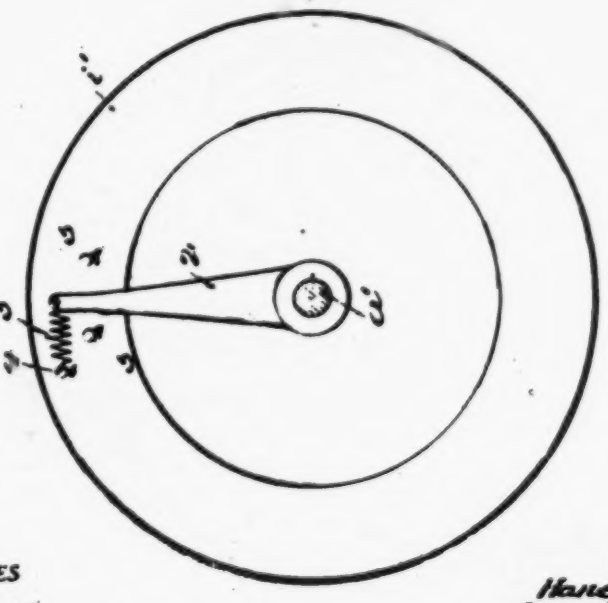


Fig. 5.



WITNESSES

INVENTORS
Hans Vogt
Joseph Marolle
BY Josef Engl.

ATTORNEYS

545377-30

MAIL ROOM MAY 29 1924 U.S. PATENT OFFICE

U. S. PATENT OFFICE MAY 31 1924 Division 23

UNITED STATES PATENT OFFICE.

JOSEF RHGL, :
JOSEPH MASSOLLE, :
HANS VOGT, : Div. 23
Serial No. 545,377, : Room 217 Paper No. 11
Filed March 20, 1922. :
Device for Phonographs with :
Linear Phonogram Carriers. :

To the Commissioner of Patents,
Washington, D.C.

Sir;

The undersigned, attorneys of record in the above entitled application, hereby appoint Messrs. Ward, Crosby & Smith, (Reg. No. 11657), a firm composed of S. Mortimer Ward, Jr., Gorham Crosby and Dyer Smith, of 233 Broadway, New York, N.Y., as associate attorneys in said application, to prosecute said application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent Office connected therewith.

Signed at New York, N.Y.

May 27- 1924.

545377-31

#12

UNITED STATES PATENT OFFICE.

RECEIVED AUG 2 1924 U.S. PATENT OFFICE

HANS VOGT,
JOSEPH MASSOLLE,
JOSEF ENGL.

Div. 35 3
Com 227

Serial No. 545,377,

Filed March 20, 1922.

Device for Phonographs with Linear Phonogram.

Hon. Commissioner of Patents,
Washington, D.C.

Sir:

The undersigned hereby revoke all previous Powers of Attorney in connection with the above entitled application.

The undersigned hereby appoint Messrs. Ward, Crosby & Smith, a firm composed of S. Mortimer Ward, Jr., Gorham Crosby and Dyer Smith, (Registration No. 11687), of 235 Broadway, New York, New York, its attorneys, with full power of substitution and revocation, to prosecute said application, to make alterations and amendments therein, to receive the patent and to transact all business in the Patent Office connected therewith.

Accepted
AUG 8 1924
J. E. Robertson
Examiner

Josef Engl.
Joseph Massolle
Joseph Vogt

We agree to the above revocation of our Power of Attorney.

AUG 3 1924

Accepted

545377-35

1925 U.S. PATENT OFFICE

Group 6[16]

IN THE UNITED STATES PATENT OFFICE. 3311

In re application of	
Hans Vogt et al,	
Device for Recording Sound Waves,	Room 105. Annex
Filed March 20, 1922.	Div. 5.
Serial No. 545,377.	

Hon. Commissioner of Patents,
Washington, D. C.

S i r :

In response to Patent Office Action of March 28th, please amend the above entitled application as follows:

Page 2, line 4, cancel "then". Line 16, cancel "phonographs with" and substitute - sound recording or reproducing apparatus embodying - . Line 17, after "carriers" insert - such as photographic sound records on film strips, or ribbons, - . Line 18, cancel "roller of" and substitute - cylinder or -. Lines 23 and 24, cancel "the operation of" and substitute - such as film strips, -.

Page 3, line 1, insert - greatly - after "thus". Lines 2 and 3, cancel "by considerable amounts". Line 10, cancel "support" and substitute - record carrier - . Line 15, correct the spelling of "conformity". Line 17, cancel "The" and substitute - Referring to Fig. 1, partially illustrating sound reproducing apparatus, the - . Line 18, after "strip" insert - bearing a photographic sound record; Line 20, after "roller" insert - r^2 - . Line 27, cancel "sleeve h the part" and substitute - casing h the light-sensitive cell - . Line 29, cancel "out of o and over" and

545377-27

substitute - from a light source (not shown), through objective $\underline{o}$, and then through - . Same line, after "rollers" insert - or idlers - .

Page 4, line 1, after "invention" cancel the comma (,) and insert - is shown in Fig. 2 - . Line 2, cancel "often caused by the teeth" and substitute - of movement often caused by the feeding of the film by the teeth on roller $\underline{r}^2$, - . Cancel lines 3, 4 and 5, and substitute - in the Fig. 1 construction, or which are caused by the mechanical vibrations of the stretches of film between rollers $\underline{r}'$ and $\underline{r}^2$, in the Fig. 1 construction, are avoided. - Lines 6, change "roller" to - sprocket -. Line 8, change "roller" to - sprocket - . Lines 8 and 9, change "transporting rollers" to - feeding sprockets - . Line 11, cancel "adhesion" and substitute - friction - . Line 22, cancel "On the reproduction" and substitute - When sound is to be reproduced from the photographic sound record on the film, - . Lines 24 and 25, cancel "its interior" and substitute - the interior of roller R. - . Line 26, after "glass" insert - for example, - . Line 27, cancel "tone indications" and substitute - sound record -.

Page 5, line 2, cancel "tone band" and substitute - film sound record - . Line 5, cancel "tone band" and substitute - film - . Line 7, cancel "of projection" and substitute - at which light is projected through the record - . Cancel the matter substituted by a previous amendment for lines 9 to 12 inclusive, and substitute - the engaging and disengaging of the feeding teeth of the film-feeding sprocket with the perforations of the film, will not affect

the speed of the film at the projection point, i.e., at the point at which light falls upon the film in recording, or at which it passes through the film in reproducing. - . Page 5, line 15, change "carried" to - carries - and also change "feed" to - feeding - ; also, insert - the customary - after "has" at the end of the line. Line 17, cancel "tone band" and substitute - film - . Line 20, cancel "pressing pulleys e and f" and substitute - pressure rollers e and f, Fig. 4. - Cancel lines 21 and 22 and substitute - member h such as a gear for example, and also the - . Line 23, insert a comma (,) after "i" . Line 25, cancel "tone band" and substitute - film - . Line 27, cancel "pulleys" and substitute - rollers - . Line 28, cancel "band" and substitute - film strip - . Cancel lines 29 and 30, and substitute - that it lies, without possibility of being shifted, upon the entire peripheral length of cylinder d from g to e, because of the feed teeth of cylinder d engaging with

Page 6, cancel lines 1 to 12 with amendments and substitute - the perforations of the film. The engagement and disengagement of the feed teeth on cylinder d, with the perforations of the film, takes place under the pressure of the rollers g and e, Fig. 4, so that vibrations or jerky motions of the film band, due to such tooth engagement or disengagement, no longer make themselves felt at the point of light projection through the same. The free ends of the film band are preferably guided by rollers (not shown) for preliminary winding up in the manner well known in picture cinematography, so that they form a loop.

It will be understood that the invention is

intended particularly for use in connection with transparent film records, on which sound is recorded photographically, by causing acoustically modulated light to act upon the film at the control point. Also that, in reproducing, light passes through the sound record on the film at the control point, and falls upon the photo-cell to set up currents corresponding, in frequency variations, to the sound record through which the light has passed. Also, that the film may pass from a supply reel on which it is wound, at the starting end, to a reel on which it is progressively wound, at the final end, as is usual in cinematography. Further, that the film contemplated may be a talking moving picture film, containing pictures in addition to the sound record. Such a record must be fed intermittently past the point at which the pictures are recorded on the film, or at which the projection light shines through the pictures in reproducing. In addition there is the need of feeding the film uniformly past the point at which the sound is recorded or reproduced. For such film the loop referred to is preferably formed, between the point of intermittent feed for picture recording or projection, and the point of uniform motion for sound recording or reproducing, the production of such loops in the film being common in cinematography.

For recording purposes a solid cylinder or roller may be employed in place of the roller 4 upon which the full width of the film strip will bear, since in recording the acoustically modulated light which is to be recorded need not pass through the film but only need act upon the sensitized upper surface thereof.

Page 6, cancel lines 13 to 16, and substitute

Serial No. 545,377------5

(6) For reproducing purposes, a specially constructed roller d is required. This is for the reason that the light from the projection light source, condensed by the lens k to a narrow line at the surface of the film, must pass through the film and fall upon a light-sensitive element, for instance ——

Page 6, cancel line 18 and substitute - The cylinder or roller d in - . Line 20, change "band" to - film - . Line 21, cancel "tone-signs" and substitute - sound record - . Same line, cancel "over" and substitute - beyond -.

Same page, cancel lines 22, 23 and 24, and substitute (7) The sound record as indicated in Fig. 3 may be located at the outer side of one row of perforations in the film. The sound record markings can, however, if desired, be located between the two rows of perforations in the film, in which case only one row of perforations would be utilized for feeding the film, these perforations being engaged by the teeth on roller d nearest to the center of cell k. In this case the sound record portions of the film would still overhang the edge of roller d, the far overhanging edge of the film.——

Same page, line 25, cancel "band" (first word). Same line, cancel "guiding" and substitute - guidance - . Line 26, cancel "with the aid of a wheel" and substitute - running over a roller - . Cancel line 27 and substitute - teeth, which roller may be an idler or may be specially driven, as desired. - .

Same page, cancel line 28, and substitute the following:

(8) Another feature may advantageously be in-

Serial No. 545,377------6

68

corporated in the invention. If the driving shaft of the tone-film revolves - .

Same page, line 29, cancel "merely" .

Page 7, line 1, cancel "still". Line 9, change "driving" to - driven - . Lines 9 and 10, cancel "running out" and substitute - stopping - . Line 10, cancel "gear" and substitute - mechanism - .

Cancel the claims and substitute the following:

69

11 16

In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of means for supporting and progressing the elongated carrier from one point to another point, and past an intermediate point at which the record is made on the carrier in recording or from which the record is taken from the carrier in reproducing, including a cylinder over a portion of the periphery of which the carrier passes adjacent to said intermediate point, a fly-wheel associated with said cylinder, and means for rotating said cylinder, under control of said fly-wheel, at uniform speed.

11 20

In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of means for supporting and progressing the elongated carrier from one point to another point, and past an intermediate point at which the record is made on the carrier in recording or from which the record is taken from the

3317

Serial No. 545,377-----7

carrier in reproducing, including a cylinder over a portion of the periphery of which the carrier passes adjacent to said intermediate point, a fly-wheel associated with said cylinder and imparting uniform rotative movement to said cylinder, a driving member, and connections for driving said fly-wheel and cylinder from said driving member including a resilient device for absorbing irregularities of speed in said driving member.

30. In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of a cylinder, a fly-wheel associated therewith, means for rotating said cylinder at uniform speed under control of said fly-wheel, means for feeding the carrier upon said cylinder at one point and off therefrom at another point and causing it to adhere closely thereto without slippage between said points, and means, between which and the record carrier acoustically modulated energy is transferred, as the carrier moves past the same, coacting with the carrier when at a position on said cylinder intermediate said two first named points.

40. In phonographic apparatus in which the sound record is photographically formed on a film ribbon of inconsiderable mass, the combination of a cylinder, a fly-wheel associated therewith, means for rotating said cylinder at uniform speed under control of said fly-wheel, means for feeding a record film ribbon upon said cylinder at one point and off therefrom at another point and causing it to adhere closely thereto without slippage between

Serial No. 545,377------8

said points, and means for directing light upon the record film ribbon at a when position on said cylinder intermediate said two first named points.

5 -

In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of means for supporting and progressing the elongated carrier from one point to another point, and past an intermediate point at which the record is made on the carrier in recording or from which the record is taken from the carrier in reproducing, including a cylinder over a portion of the periphery of which the carrier passes adjacent to said intermediate point, rollers for pressing the carrier against said cylinder at the points at which it is fed on to and off from the same, a fly-wheel associated with said cylinder, and means for rotating said cylinder, under control of said fly-wheel, at uniform speed.

6 -

In phonographic apparatus in which the sound record is formed on an elongated ribbon of inconsiderable mass, having feeding perforations therein, the combination of means for supporting and progressing the record ribbon from one point to another point and past an intermediate point at which the record is made on the ribbon in recording or from which the record is taken from the ribbon in reproducing, including a toothed cylinder over a portion of which the ribbon passes adjacent to said intermediate point, the teeth of said cylinder en-

gaging the perforations of the ribbon, a fly-wheel associated with said cylinder, and means for rotating said cylinder, under control of said fly-wheel at uniform speed.

(Cl 61-

In phonographic apparatus in which the sound record is formed on an elongated ribbon of inconsiderable mass, having feeding perforations therein, the combination of means for supporting and progressing the record ribbon from one point to another point and past an intermediate point at which the record is made on the ribbon in recording or from which the record is taken from the ribbon in reproducing, including a cylinder for supporting the record at said intermediate point, a fly-wheel associated with said cylinder for causing uniform motion to be imparted to said cylinder, toothed means engaging the perforations of the ribbon for feeding the latter over the cylinder, contacting with the ribbon and means to prevent vibration of the ribbon when said toothed means are engaging or disengaging the perforations of the ribbon.

47 Cl-

In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of means for supporting and progressing the elongated carrier from one point to another point, and past an intermediate point at which the record is made on the carrier in recording or from which the record is taken from the carrier in reproducing, including a cylinder over a portion of the periphery of which the carrier passes adjacent to

said intermediate point, a fly-wheel, a shaft on which said cylinder and fly-wheel are both secured, a driving member coaxial with said shaft, a resilient connection between said driving member and fly-wheel, and stop means for limiting the amount of yielding of said resilient connection.

9 - F' (Cl. 8) Sole

In phonographic apparatus in which the sound record is photographically formed on a film ribbon of inconsiderable mass, the combination of a cylinder, means for feeding a record film ribbon upon said cylinder at one point and off therefrom at another point and causing it to adhere thereto between said points, said cylinder and ribbon being so arranged that the sound-record bearing portion of said ribbon overhangs the edge of said cylinder, means for directing light through said portion of said ribbon as the latter passes over said cylinder, and means for rotating said cylinder uniformly.

~~10~~

9 In phonographic apparatus in which the sound record is photographically formed on a film ribbon of inconsiderable mass, the combination of a cylinder, having feeding teeth thereon, adapted to coact with perforations in the film ribbon, means for rotating said cylinder, means for feeding the ribbon on to said cylinder to engage said teeth with the ribbon perforations, and off from the cylinder at another point, the film ribbon overhanging the edge of the cylinder, a photocell, and means for directing light through the over-

545377-40

Serial No. 545,377--------11

~~hanging portion of the ribbon onto said photo-cell.~~

REMARKS.

In regard to the drawings, the present attorneys are uncertain what corrections are necessary and the Examiner is requested to state what corrections are necessary. It appears from the last Office action, dated March 28, 1924 and from the previous amendment, filed March 24, 1924, that the Examiner agreed to admit the sheet of drawings showing Figs. 5 and 6. This was apparently upon the agreement of the attorney to amend Figs. 5 and 6 to change the pulley to a gear, and apparently the Chief Draftsman was thereupon authorized to make such change.

If the question should be opened up afresh, it appears from the original disclosure on page 7 that a driving member is to be connected to drive the fly-wheel and the cylinder d and the shaft on which the same are mounted, by a connection comprising a spring. No specific manner of connecting the spring is described, but certainly an obvious way to make the connection is to secure an arm on one of the parts and connect this arm with the other part by the spring, as is indicated in Fig. 5. Also, the original description calls for a pair of fixed stops to limit the play of the spring, and an obvious way to effect this is certainly to position the stops one on each side of the arm referred to, as is shown in Fig. 5.

Fig. 6 is, of course, the same as original Fig. 5 with the addition of the driving connection above referred to.

There is, of course, no invention in the specific

manner in which the spring is connected, and it would seem proper to illustrate by a showing of any obvious and usual construction for securing the spring, such as would occur to any shopman and such as is illustrated in the Figs. 5 and 6.

The description part of the application has been considerably amended in order to make the meaning clearer and to put the same in more idiomatic English, it being noted that the application was originally prepared abroad.

The claims as formerly worded have been cancelled and new claims are submitted herewith which are thought to point out the invention more clearly. These claims are thought to distinguish from the references and certainly to involve invention.

The problem which applicants have solved was not present in the case of any of the prior patentees. The references all refer to disc or cylinder record talking machines, in which case uniform speed may be obtained by simply placing a fly-wheel mass on the axis, or connected with the axis of the record support. The talking machine records themselves have considerable mass which aids in stabilizing the speed of rotation.

In the case of the present application a sound record film, similar to the ordinary motion picture film, or other elongated carrier of inconsiderable mass, serves for the sound record, the phrase "an elongated carrier of inconsiderable mass," in the claims referring to a film or possibly a wire or similar lengthy carrier of very slight weight. This carrier or film is fed from a reel at one end of the apparatus to a takeup reel at the other end. In the progress of the film it passes a point at which the record is made on

the carrier, in recording, and at which the record is taken from the carrier in reproducing. With the system illustrated the record is made by projecting light onto the film at this point in its travel and reproducing light is caused to pass through the film at this point to fall on a light sensitive cell. In both cases the problem is one of giving the film a very uniform and constant movement at this point. There is nothing in the talking machine references to indicate how this should be done. So far as these references show it would be sufficient to place a fly-wheel mass at either end of the moving film or possibly at some other point without particular thought as to what point was selected. This would not be sufficient in the present case, because of slippage of the film or change of speed of one kind or another between the point at which the fly-wheel is located and the point at which the record is taken off. For example, the feeding perforations in the film, which are engaged by the sprocket to feed the film, become worn and permit slippage. It may also be considered that the film used in applicants' actual practice is a talking moving picture film containing pictures as well as a sound record, and this film passes through a moving picture projecting machine at one point at which the film has an intermittent step-by-step motion. It is necessary to give the film an absolutely uniform constant motion at another point at which the sound record is made or taken off, and it is more difficult to do this because of the fact that the film band itself has practically no mass momentum.

The claims as now written bring in the character of the film or record carrier and the fact that it moves from one point to a distant point and must be given a con-

stant movement at an intermediate point at which the record is made or taken off. Most of the claims are limited to means for producing the uniform or regular movement at this one intermediate point at which the record is made or is taken off the film.

Briefly referring to the references, the French patent No. 414,788 is a talking machine in which the turn table for the disc record is itself weighted to serve as a fly-wheel for the spindle of the disc record. Applicants' problem involving the necessity for rendering the movement of a film strip uniform at the one definite poin in the forward movement of the film at which its motion must be uniform does not arise here.

British (Kramer) patent No. 19,667 is no better, the fly-wheel being on the same shaft as the turn table for the disc. Incidentally the spring shown does not act in the same way as the elastic coupling of applicants. Since this spring does not serve as an elastic coupling between the driving member of the fly-wheel and the fly-wheel itself. In Kramer the spring is between the fly-wheel and the turn table, and furthermore it does not act as a driving spring connection as in the present case, but merely as a means for exerting pressure on members to clamp them together.

French patent to Martinez, No. 416,858, merely shows a disc turn table the spindle of which is rotated by an electric motor or by a spring motor, applicants' special problem not arising.

Wale, patent No. 255,220, uses a spring as a power indicating device, the spring being tensioned as one

is pulled ahead of the other so that the power absorbed by the spring may be indicated and recorded.

Also, in patent to Moore, No. 930,605, the springs are used for the same purpose as in Wale, the power consumed in tensioning the spring being measured and recorded. In applicants' case the spring is used for taking up and absorbing irregularities of speed in the driving device so that the same will not noticeably affect the speed of rotation of the fly-wheel.

Referring briefly to the claims in detail, claim 1 is limited to a construction in which the elongated record carrier is moved from one point to a distant point and past an intermediate point at which the record is made or at which the record is taken off the carrier, such means including a cylinder over a portion of which the carrier passes adjacent to this critical point, together with a fly-wheel for giving uniform speed at this point. Nothing of the kind is shown in the references which have been described above. Also while, of course, it is old generally speaking to use fly-wheels, it is not old to supply a fly-wheel in such a combination and in such a manner as is here claimed. The invention consists of a means for providing the uniform motion at or adjacent to the point at which it is needed in connection with the use of a film or similar record carrier.

Claim 2 is similar and brings in additionally the resilient coupling. Claim 3 is similar but is additionally limited to include a device such as the light source and associated parts for transferring acoustically modulated energy at the critical point referred to. Claim 4 is similar but is more specific in its inclusion of means for directing

light upon the film at the point referred to.

Claim 5 is similar to claim 1, but is more limited in including the rollers for pressing the carrier against the cylinder at the points at which it is fed on to and off from the same.

Claim 6 is similar to the above and to claim 5, but is more limited in including the teeth on the cylinder for feeding the film positively from the point at which it is fed on to the cylinder to the point at which it leaves the same. Claim 7 is similar.

Claim 8 is similar to claims 1 and 2, but is somewhat more limited to the resilient connection with the stops.

Claims 9 and 10 are specific to constructions in which the film overhangs the edge of the cylinder or roller over which it is fed, so that the light can pass through the sound record on the overhanging part of the film and thus fall upon the photo-cell. Such a construction is, of course, not shown in the references and is thought patentable.

For all of the above reasons an allowance is requested.

Respectfully submitted,

HANS VOGT, JOSEPH MASSOLLE and JOSEF ENGL

By Ward, Crosby and Smith
Its Attorneys

New York, N.Y.
March 25, 1925.

RM.AM

545877-16

U.S. PATENT OFFICE

IN THE UNITED STATES PATENT OFFICE.

In re application of	)	
Hans Vogt et al,	)	
Device for Recording Sound Waves,	)	Room 108, Annex
Filed March 20, 1922.	)	Div. 5
Serial No. 545,377.	)	

New York, N.Y.

March 27, 1925.

Hon. Commissioner of Patents,
Washington, D. C.

Supplementary to Amendment Filed March 25, 1925.

S i r :

Please amend the above entitled application as follows:

Page 6, line 17, cancel "at the" (last two words of line).

This amending was inadvertently omitted from the amendment of March 25, 1925.

Respectfully submitted,

HANS VOGT, JOSEPH MASSOLLE AND JOSEF ENGL.

By Ward Canby and Smith
Their Attorneys

DS.AM

62

Div. 5 Room 10+ DEPARTMENT OF COMMERCE Paper No. 18

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name. G/EMH

UNITED STATES PATENT OFFICE
WASHINGTON Sept. 5, 1925

SEP 5 1925

Please find below a communication from the EXAMINER in charge of this application

Thomas E. Robertson
Commissioner of Patents

Ward, Crosby & Smith
233 Broadway
New York, N. Y.

Applicant: Hans Vogt et al.

Ser. No. 545,377
Filed Mar. 20, 1922
For Device for Phonographs With Linear Phonogram Carriers.

Responsive to Amendment C filed Mar. 25, 1925 and Amendment D filed Mar. 28, 1925.

Claims 1, 3, 4, 6 and 7 are each and all rejected on

1,185,056 Byron May 30, 1916 274-43,

in view of

French patent 472,467 Dragoumis et al. of 1914 (1 sheet) 274-11.

The French patent shows the use of a fly wheel which is mounted on the same shaft as the cylinder 1 which engages the film.

Claims 2 and 8 are each rejected on Byron and Dragoumis, cited, in view of

492,898 Westinghouse et al. Mar. 7, 1893 64-96,

which shows a fly-wheel which is resiliently coupled with the driving member.

Claim 5 is rejected on Byron and Dragoumis, cited, in view of

German patent 85,751 Alber of 1919 (1 sheet) 274-11,

which shows the rollers 6, 6 used to press the film 3 against the cylinder 2.

J. Homer Smith
Actg. Examiner, Div. 5.

545377-54

Div. 5 Room 10b ANNEX Paper No. 20

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

G/EIH

Oct. 6, 1925

MAILED

OCT 6 1925

Please find below a communication from the EXAMINER in charge of this application

Thomas E. Robertson
Commissioner of Patents

Applicant: Hans Vogt et al.

Ser. No. 545,377
Filed Mar. 20, 1922
For Device for Phonographs With Linear Phonogram Carriers.

Ward, Crosby & Smith
233 Broadway
New York, N. Y.

This action is supplemental to the Office action of Sept. 5, 1925.

Claim 9 is rejected on Byron and Dragoumis, cited, in view of

German patent 363,640 Aftergut of 1922 (1 sheet) 274-11,

which shows the use of a film overhanging the cylinder over which it is passed, (Fig. 3). It is merely a matter of arrangement to cause the film 10, shown by Byron to overhang the cylinder 13, in order to pass light through the photographed sound record shown by a wavy black line in Fig. 2.

Claim 10 is rejected on the grounds of aggregation. The combination of the mechanical elements used to drive the film and a photo-cell onto which light is directed through the film, is not patentable, since these parts are entirely independent of one another, and have no special cooperation with each other, See Ex parte Thomson, C. D. 1905, 18 O. G. 266 and Ex parte Griffith 1898 C. D., 85 O. G. 936.

The German patent 85,751 to Alber of 1919, cited in the last Office letter should be -

Swiss patent 85,751 to Alber Oct. 11, 1919 Kl. 69, (1 sheet) 274-11.

J. E. MacNab
Examiner, Div. 5.

545377-56

MAR 6 1926 PATENT OFFICE

21 E

IN THE UNITED STATES PATENT OFFICE

In re application of HANS VOGT, JOSEPH MASSOLLE, and JOSEF ENGL,

Serial No. 545,377,

Filed March 20, 1922,

For DEVICE FOR PHONOGRAPHS WITH LINEAR PHONOGRAM CARRIERS.

Div. 5,

Room 108 Annex.

New York, N.Y.,

March 4, 1926.

Hon. Commissioner of Patents,
Washington, D. C.

S i r :

In response to Patent Office actions of September 5, 1925 and October 6, 1925, please amend the above entitled application as follows:

Claim 2, line 12, cancel "roller" and substitute - cylinder - .

Claim 3, line 1, correct the spelling of "phonographic". Line 8, cancel "thereto" and substitute - closely thereto without slippage - .

Claim 4, line 8, insert - closely - after "adhere".

Cancel claim 9.

Claim 10, line 3, after "cylinder," insert - open at one end, - . Line 9, after "cylinder," insert - at the open end thereof, - . Line 10, after "cell," insert - mounted within said cylinder, to partly extend out of the open end thereof, - . Renumber claim 10 as 9.

R E M A R K S

The Examiner's actions combine either two or three references in each of the claims without anticipat-

Sn 545377-5

ing the invention claimed even if it be assumed that all of these references can be combined together without amounting to invention.

Referring to claim 1, this calls for locating the fly-wheel at the intermediate point at which the record is made, or from which the record is taken in reproducing. The Byron patent does show means for recording photographically at the intermediate point, namely, where the film passes over the guide pulleys 13. Applicants' invention, as claimed, consists in arranging a fly-wheel at this point so that the movement of the film will be uniform, at all times at this point.

The Examiner states that the French patent to Dragoumis shows the use of a fly-wheel which is mounted on the same shaft as the cylinder 1 which engages the film. The so-called fly-wheel in Dragoumis is not referred to in the specification and is apparently a pulley over which a belt runs to impart rotation to cylinder 1. It cannot be said whether this pulley acts as a fly-wheel or not. Furthermore, there is nothing to positively prevent slippage of the film on the smooth cylinder 1, and it would be of little use to apply a fly-wheel mass to maintain cylinder 1 uniform in rotation, if the film itself was not maintained at uniform speed at the same point. Therefore it appears that the inventor had no thought or made no disclosure of the use of a fly-wheel at this point to maintain the film uniform in speed.

Moreover, and this is the chief point of the matter, the alleged fly-wheel of Dragoumis is applied at

the end of the travel of the film and not at an intermediate point. The Examiner's idea is evidently that invention would not be involved in transferring the alleged fly-wheel of Dragoumis from the end of his system to the intermediate point, represented by guide pulleys 13 of the Byron patent. It is thought that invention does exist in locating a fly-wheel at this intermediate point at which applicants make their record, which is the one point at which the motion must be kept uniform in order to have a successful result with a system such as applicants. The obvious thing is to locate the fly-wheel at one of the end points of the system, which is the point at which Dragoumis locates his pulley, which the Examiner considers a fly-wheel. In recording at an intermediate point, there is likely to be slippage of the film or change of speed between the intermediate point at which the record is made and one of the end points. This may result because of wearing of sprocket holes in the film, etc. The invention is of a simple character. Nevertheless it is this conception, which is not suggested by Byron and certainly is not suggested by Dragoumis, which has enabled applicants to make substantially perfect photographic sound records on the film and to reproduce same without distortion; results which were previously rendered impossible by the mechanical defect of lack of uniform speed at the point at which the records were made or reproduced. Accordingly the claim is thought allowable.

Claim 6 is similar, but is slightly more specific.

Claims 3 and 4 distinguish in the same way and

in addition by including means for causing the film to adhere closely thereto without slippage between the point at which it is fed on and between the point at which it is fed off from the cylinder. No such means is found in Byron. The same remarks hold in connection with claim 5 which specifically refers to the rollers, which are the means for pressing the carrier band against the cylinder at the two points referred to. The Examiner has rejected this claim on a combination of three references. It is thought that the Swiss patent cited cannot be combined with Byron and the French patent to anticipate applicants' inventive thought. Applicants in this claim have not only provided for absolutely uniform rotation of the cylinder at the intermediate point, which is not disclosed in Byron and Dragoumis, but they additionally provide specific means for holding the film against this roller, at this intermediate point so that the sprocket teeth will be held in close contact with the sprocket holes in the film and that the film accordingly will have the same uniform speed as this roller without any possiblity of jumping. No such conception is found in the three patents cited together.

Reconsideration of claims 2 and 8 is requested, which the Examiner has rejected on the combination of three patents. Claim 2 covers the same combination as claim 1, with the addition of resilient driving connection between the driving member and the fly-wheel, at this intermediate point. This latter provision has the purpose of absorbing irregularities of speed in the driving member and thus make it more certain that the film will have a constant uniform speed at the intermediate point referred

to. The Westinghouse patent merely shows that it is old to have a spring connection between two shafts, one of which drives the other. Applicants' invention consists in the combination of the various elements recited. Westinghouse does not suggest the advisability of including the resilient device at the point and in the combination of applicants.

Claim 8 is similar and includes additionally a stop means for limiting the amount of yielding of the resilient connection.

Claim 9, previously 10, has been amended to overcome the rejection of the same as an aggregation. A combination with the cell is now shown, in as much as the cell is mounted within the gear or cylinder so that it is protected, and a compact arrangement is made, with the film overhanging so that light may fall upon the cell.

For the above reasons an allowance is requested.

Respectfully submitted,

HANS VOGT, JOSEPH MASSOLLE, and JOSEF ENGL

By Ward, Crosby and Smith
Their Attorneys

Div. 5 Room 108 Annex

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON June 19, 1926

Paper No. 22

G/EH

MAILED

JUN 19 1926

Please find below a communication from the EXAMINER in charge of this application

Thomas E. Robertson
Commissioner of Patents

Applicant: Hans Vogt et al.

Ser. No. 545,377
Filed Mar. 20, 1922
For Device for Phonographs With Linear Phonograph Carriers.

Ward, Crosby & Smith
233 Broadway
New York, N. Y.

Responsive to Amendment E filed Mar. 6, 1926.

Division is required between claims 1 to 8, inclusive, and claim 9. Claims 1 to 8, inclusive, are drawn to a combination of means for progressing a film or carrier from one point to the other, and a flywheel for imparting uniform motion to the film. The combination claimed in claims 1 to 8 is independent of the combination intended to be covered by claim 9. These two distinct and independent combinations of elements are not dependent upon each other and do not mutually contribute to produce a single result. See Rule 41.

The claims are each and all again rejected on the references and for the reasons of record. The Swiss patent to Alber, for instance, shows a phonographic apparatus in which the sound record is formed on an elongated carrier, the combination of means A, B, 6, 2 for supporting and progressing the carrier 5 from one point to another, a cylinder 2 over a portion of the periphery of which the carrier passes adjacent an intermediate point 4, at which the sound record is produced or reproduced, and rollers 6, 6 for pressing the carrier against the cylinder 2. Merely to place the driving means at the axis of the cylinder 2 does not amount to invention, and is shown to be old by Dragoumis et al. Furthermore, to substitute for the driving means of Dragoumis the flexible coupling of Westinghouse does not amou t to inventive skill. The obvious and expected result is obtained by this substitution, and does not require the exercise of inventive skill.

Submitted

The claims are further rejected as drawn to a combination not adequately shown on the drawing. Applicant claims the combination of means for progressing the carrier or film from one point to another, a cylinder and a flywheel associated with said cylinder, and means to rotate the cylinder at uniform speed. This combination of elements is not shown by any one figure of the drawing, nor does a combination of two or more figures show the combination claimed. All the claims should read upon the device shown in a single figure. See Ex parte Welch 1900 C. D. 190, 93 O. G. 2104.

Claim 9, formerly claim 10, is again further rejected as being drawn to an aggregation of elements. No cooperation is seen to exist between the cylinder open at one end, the photo-cell and means for directing light onto the photo-cell. As the claim is at present drawn, the cylinder may be closed at both ends and the light will be able to pass through the overhanging portion of the film onto the photo-cell.

L.J.G.

J. R. MacNab
Examiner.

RECEIVED
JUN
U.S. PATENT OFFICE

41

Division 5, Paper No. 23

IN THE UNITED STATES PATENT OFFICE

3327

In re application of HANS VOGT, JOSEPH MASSOLLE, and JOSEF ENGL,

Serial No. 545,377,

Filed March 20, 1922,

For DEVICE FOR PHONOGRAPHS WITH LINEAR PHONOGRAM CARRIERS.

Div. 5,

Room 108 Annex

New York, N.Y., June 17, 1927.

Hon. Commissioner of Patents,
Washington, D. C.

S i r :

In response to Patent Office action of June 19, 1926, please amend the above entitled application as follows:

Cancel claim 5.

Cancel claim 9 and substitute the following:

(7) 41 807 In phonographic apparatus in which the sound record is photographically formed on a film of ribbon of inconsiderable mass, the combination of a cylinder, a fly-wheel therewith, means for rotating said cylinder at uniform speed under control of said fly-wheel, means for feeding a record film onto and off therefrom at another point upon said cylinder at one point, and causing it to adhere closely thereto without slippage between said points, said film record being arranged to overhang one end of the cylinder, a photo-cell mounted within and positioned inwardly of the overhanging portion of the film, and means for directing light through the overhanging portion of the ribbon onto said photo-cell.

41(62.9) fore

Add 41

REMARKS

Claim 9 has been amended so as to overcome the requirment for division, it is believed. This covers the same combination as the remaining claims and the photo-cell.

8 cls

545377-64

ces. additionally, so as to be specific to the invention covered in the other claims. It is also believed that this claim as vended is not an aggregation. A compact and efficient arrangement is made by placing the photo-cell inside the cylinder, and co-operation exists between the cylinder and the cell because the cylinder forms the enclosure for the cell.

As to the remaining claims, the Swiss patent to Alber lacks the fly-wheel associated with the cylinder. Applicants' invention comprises the point which they consider very important, of locating the fly-wheel at this inter-mediate point at which they make their photographic sound record, which is the one point at which the motion must be kept uniform in order to have a really successful result. The Swiss patent states on page 2, second column, lines 3 to 8, that the drive and the regulation of the speed is in every case caused by the mechanism of the sound reproducing apparatus if the film carries also pictures to be reproduced. This means the usual speed governor which is not equivalent to a fly-wheel in this case, since it would not give the result of uniform motion for a film of inconsiderable mass

It also also appears that Alber cannot make use of a fly-wheel at this point since the travel of his film has to be frequently reversed because of the forward and backward arrangement of his sound record, and a fly-wheel would interrupt the working of the apparatus for too long a period. It is, therefore, clear that Alber does not in any way suggest the possibility of having a fly-wheel at this point in such a system such as Applicants.

The Examiner states that Bragounis places the driving means at the axis of the cylinder 2. Bragounis

545377

merely indicates a pulley which is not necessarily a fly-wheel and should not be considered a fly-wheel without further evidence. Also, he does not locate it at an intermediate point in the system, but at one of the end points of his system; in recording at an intermediate point, with drive from the end, there is likely to be slippage of the film, or change of the speed between the intermediate point at which the record is made and one of the end points. This may be the result of wearing of sprocket holes in the film, etc. It therefore seems clear that the combination of Alber and Dragoumis fails to show either the combination or the inventive conception which lies back of the combination; namely, an arrangement by which the film may be given uniform motion at the very point at which the record is made thereon. This distinction is made in all of the claims.

Certain specific limitations additionally appear in various of the claims. Thus claim 3, lines 9 and 10, includes means between which and the record carrier acoustically modulated energy is transferred, as the carrier moves past the same, this broadly describing the photo-cell.

Claim 6 includes the positive means for preventing slippage between the cylinder and the ribbons; namely, the teeth on the cylinder, and claim 7 includes the same together with the means to prevent vibration of the ribbon when the tooth means are engaging or disengaging the perforations of the ribbons. It will be noted that this claim includes all of the various instrumentalities which insure the uniform passage of the film past the point of recording, two of the three means involved being absent in Alber.

Claim 2 includes the resilient device for absorbing irregularities of speed in the driving member, and claim 8 is more specific to this feature of the resilient connection between driving member and fly-wheel, since it additionally includes the stop means for limiting the amount of yielding of the resilient connection. The patent to Westinghouse shows a flexible coupling between a driving and a driven member in a shaft coupling which is of course broadly old. This patent does not suggest the combinations claims by applicant; namely, a resilient connection between the driving member and the fly-wheel in such a combination as applicants, where the intention is to provide an absolutely uniform movement for the member connected to the fly-wheel and where the elastic connection is inserted to compensate for speed or fluctuations at time when the speed of the fly-wheel may be too low to accomplish this purpose alone. It is believed that the patents cited cannot be combined properly to anticipate this combination.

As to the further ground of rejection that the claims are drawn to combinations which are not show by anyone figure of the drawing nor by a combination of two or more figures, it is believed that this is incorrect. Figures 1 and 6 together apparently show all the elements of the combinations claimed, except that the flexible connection is shown specifically in Figure 5. The driving means is represented by the member h. It certainly is no ground for rejection of the claims that all of the elements of all of the claims are not shown in a single figure, and in many cases it is not possible to so arrange a single figure of the drawings as to show all of the

Ser. No. 545,377~~3331-6~~

elements of an invention. If required after reconsideration, however, an effort will be made to provide one figure which will indicate all of the elements claimed.

A reconsideration and an early allowance are requested.

Respectfully submitted,

HANS VOGT, JOSEPH MASSOLLE,
and JOSEF HEGL.

By Ward, Crosby and Smith
Their Attorneys

545377-6B

76

Box. 5 Room 108 ANNEX

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

G/EEL

Paper No. 24

All communications from regarding this application should give the name and number, date of filing, and name of the applicant

Please find below a communication from the EXAMINER in charge of this application.

Thomas E. Robertson
Commissioner of Patents.

November 4, 1927.

Ward, Crosby & Smith,
233 Broadway,
New York, N. Y.

Applicant: Hans Vogt, Joseph Massolle and Josef Engl
Ser. No. 545577
Filed March 30, 1922
For Device for Phonographs with Linear Phonogram Carriers

MAILED

NOV 4 1927

In response to amendment of June 18, 1927.

The following additional references are made of record:

Emory,	1,292,448,	January 28, 1919,	247-5
Jaycox et al,	1,449,327,	March 20, 1923,	274-5

Page 4, lines 6 and 8, V and V_2 do not appear in Fig. 2 of the drawing. Line 17, "spring-supported rollers" is objectionable as not shown by the drawing.

The use of the phrase "tone-carrier" in the specification to indicate the record carrier, is objectionable as being inapt.

Claims 1, and 3-7 inclusive, are rejected on Emory, cited, who shows in a moving picture apparatus in which the picture record is formed on an elongated carrier of inconsiderable mass, the combination of means 118, 106, and 89 for supporting and progressing the elongated carrier from one point to another point, and past an intermediate point as at 34, at which the record is made on the carrier or from which it is reprodnced, including a cylinder 106, over a portion of the periphery of which the carrier passes adjacent to said point, a fly-wheel 96 associated with said cylinder, and means 90, 91 and 58 for rotating said cylinder under control of said fly-wheel at uniform speed. To use a sound record instead of a picture record does not involve patentability.

Claim 2 is also rejected on Emory, since there appears to be no invention in substituting the resilient driving mechanism of Westinghouse, Moore or Jaycox for that shown by Emory.

Claim 3, line 10, claim 4, line 11, - "at a point on said cylinder" is objectionable as being inaccurate. If the claims are

THIS ACTION MUST BE RESPONDED TO WITHIN SIX MONTHS.

545577-69

drawn to the species of the invention shown by Figs. 5 and 6, and which is covered by the remaining claims, the light does not coact with the carrier at any point on the cylinder, but does coact with the film at a point of the overhanging portion of the film.

Claim 7 is further rejected as being functional. Lines 14-16 of the claim, "means ----- ribbon", is indefinite, incomplete and functional. The essence of the invention lies in the prevention of vibration of the ribbon when passing over the cylinder. A claim for a machine which is drafted to cover any means which any one ever may discover of producing the result sought is invalid because functional. See Ex Parte Gillman 341 O.G. 255, or Heidbonck et al vs. McKesson 290 Fed. Rep. 665.

Claims 1-7 inclusive, "a fly-wheel associated therewith", is objectionable as being indefinite and functional. The object of applicant's invention is to give to the record carrier of inconsiderable mass, at the point of reproducing or recording, the property of a weighty mass. To associate the flywheel with the cylinder by means of gearing, pulleys, etc., would defeat the object of the invention, since in that case the momentum of the flywheel would merely absorb irregularities in the driving mechanism and would not affect vibration of the record carrier, which is the object of the invention.

Claim 9, line 8, "between said points" is objectionable as being without an antecedent in the claim. It is not known to what points this refers. Line 10, "a photo-cell mounted within said cylinder" is objectionable as being inaccurate, since part of the photo-cell is mounted outside the cylinder to allow the light to pass through the portion of the film overhanging the cylinder.

Claim 9 is rejected as being inaccurate.

Claim 8 is at present free from references.

J. F. McCloskey
Examiner.
545377-10

78

C3

RECEIVED

1928

IN THE UNITED STATES PATENT OFFICE

In re application of HANS VOGT, et al, Ser. No. 545,377, Filed March 20, 1928, For Device for Phonographs with Linear Phonogram Carriers.	3332 Div. 5, Room 108 Annex.

May 2, 1928,
New York, N.Y.

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

Responsive to the Office action of November 4, 1927:

Instructions for amending the drawing in accordance with the Examiner's suggestions are given in a separate letter to the Official draftsman.

In the specification, page 2, line 6, cancel "tone carrier" and substitute -- record carrier --. Line 18, cancel "tone carrier" and substitute -- record carrier --.

Claim 2, line 11, after "with" insert -- and imparting uniform rotational movement to --.

Claim 3, line 11, after "carrier" insert --when--. Cancel "point" and substitute -- position --.

Claim 6, line 10, after "ribbon" insert --when--. Cancel "point" and substitute -- position --.

Claim 7, line 14, after "means" insert -- contacting with the ribbon --. After "vibration" insert

545377-78

-- thereof --. Cancel "of the ribbon".

Claim 9, line 6, cancel "upon" and substitute --onto--. Line 7, after "point" insert --and off therefrom at another point--. Cancel "it" and substitute -- the film --. Line 8, cancel "thereto" and substitute --to the cylinder--. Line 10, cancel "mounted within" and substitute --positioned said cylinder inwardly of the overhanging portion of the film--. Line 11, cancel "the" and substitute --said--. Line 12, cancel "of the ribbon".

Kindly add the following new claim:

-- 10. The method of translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound, which comprises flexing the film arcuately longitudinally at the point of translation and rapidly and uniformly moving the film in a circumferential direction past said point. --

REMARKS

Claims which the Examiner rejects on the Emory patent define means for rotating a film carrying cylinder under control of a fly wheel at a uniform speed, or equivalent means. The Emory patent, however, is confined to the intermittent projection of a picture film. At the point where picture films are projected, the film motion is intermittent and in this respect the Emory mechanism is no exception to the usual practice (see the intermittent sprocket 106 and Geneva gear box in Emory Fig. 5).

The Emory patent must therefore be withdrawn as an alleged reference and thereupon the claims will be free from references and ready for allowance in view of the correction of the informalities herewith. In the absence of references, applicant should not be required to limit all of his claims to his specific preferred embodiments as to

the manner in which the fly wheel is associated with the cylinder. Clearly, many objects and advantages of the invention would not be defeated, even if the fly wheel were connected through properly constructed gearing, etc.

A new method claim is added herewith broadly covering one phase of applicant's invention which is not suggested in any way by the prior art. It will be appreciated that the mere flexing of the film into an arcuate shape and advancing the same circumferentially, may contribute greatly to the elimination of extraneous vibrations regardless of the form of mechanism used for supporting and advancing the film.

Respectfully submitted,

Attorneys for Applicants.

RECEIVED
MAY 7 1928
Division 5. Paper No. 26

IN THE UNITED STATES PATENT OFFICE

In re application of
HANS VOGT, et al,
Ser. No. 545,377,
Filed March 20, 1922,
For Device for Phonographs with
Linear Phonogram Carriers.

Div. 5
Room 106 Annex

Woolworth Bldg
New York, N.Y.,
May 2, 1928.

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

It is respectfully requested that the Official draftsman amend the drawings in the above entitled case, as follows:

In Fig. 2, the two small pinions should be designated respectively V and V_2 instead of r_1 and r_2.

In Fig. 2, apply springs to the supports of rollers dr_1 and dr_2, as indicated in red on the enclosed print and as set forth in the specification.

Kindly charge the cost of the above changes to the account of the undersigned and send the undersigned a complete set of photoprints of the drawings after these amendments have been made.

Respectfully submitted,

Ward & Crosby
Attorneys for Applicants.

CORRECTION
MAY 19 1928
ACCOUNT
ACCOUNT CHARGED
FINANCIAL CLERK
CORRECTED
JUN 14 1928
PRINTS ORDERED
MAY 14 1928
RECEIVED MAY 15 1928
RECEIVED IN DIV. 5
MAY 7 1928

545377-76

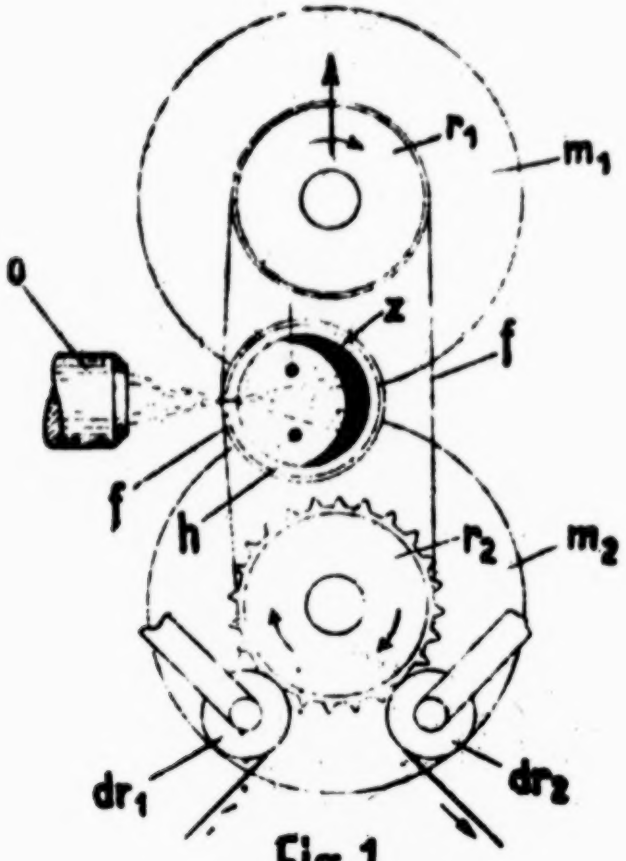


Fig 1

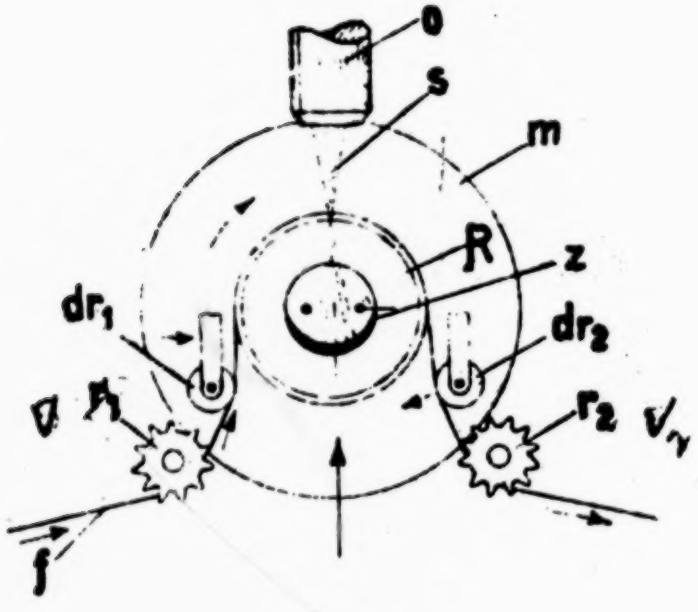


Fig. 2

545377-76

DIV 8

37/12

8-151/2

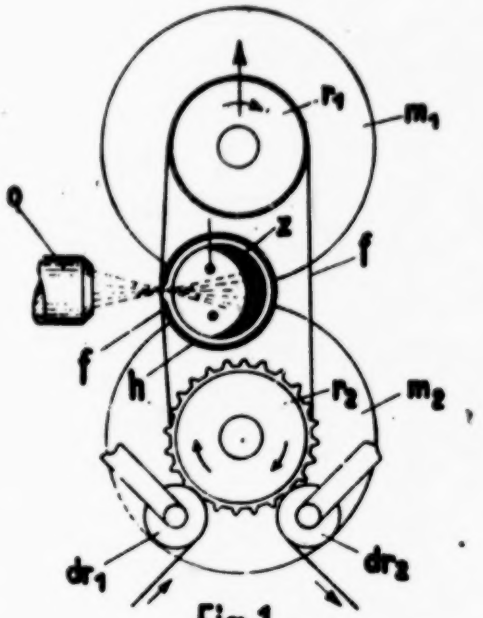


Fig 1

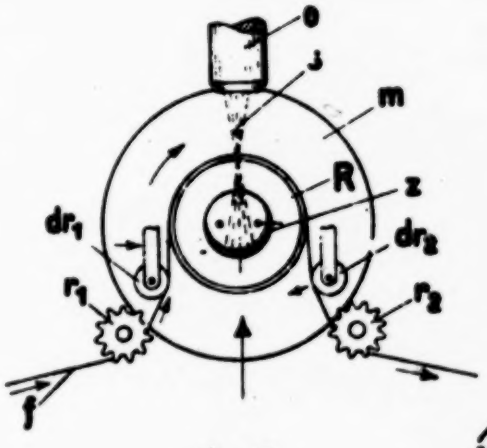


Fig. 2

Inventors
H. Vogt
J. Massolle
J. Engl.

by

Attorneys

84

RECEIVED
DEC 6 1928

3335

IN THE UNITED STATES PATENT OFFICE

In re application of
HANS VOGT, et al,
Ser. No. 545,377,
Filed March 20, 1923,
For Device for Phonographs with Linear Phonogram Carriers.

Div. 5
Room 108 Annex

December 5, 1928,
New York, N.Y.

Hon. Commissioner of Patents,
Washington, D.C.

Sir:

Supplementing our amendment dated May 2, 1928, kindly amend the above entitled application as follows:

In the specification, page 6, after line 21 insert:

The light collected by the object glass 12 to a narrow line, comes from a suitable known means or source of light projection so arranged, as indicated for example by the dotted lines in Figs. 3 and 4, that the converged narrow line of light is substantially focused or impinges upon the area of translation on the film as a line running transversely of the direction of movement of the film.

Kindly add the following new claims:

545377-28

3336

Ser.No. 545,377------2

25

4 10 . An apparatus for translating sound vibrations representative of speech, music or the like, to or from a film record by the use of light varied in accordance with the sound, which comprises means for imparting to the film a rapid and uniform motion longitudinally of the film and for retaining the moving film under tension at the area of translation, a source of light projection for providing a line of said light in fixed position, and an objective lens in the neighborhood of said area of translation on the film but spaced therefrom for collecting said projected light and directing the same as a converged narrow line impinging upon said area of translation transversely of the direction of movement of the film.

11 12. An apparatus for translating sound vibrations representative of speech, music or the like, to or from a film record by the use of a line of light varied in accordance with the sound, which comprises means for imparting to the film a rapid and uniform motion longitudinally of the film, a source of light projection for providing said light, and an objective lens in the neighborhood of the area of translation on the film but spaced therefrom for collecting said projected light and directing the same as a converging narrow line of light impinging directly on to the film at a point in the neighborhood of the focal point of said lens.

17

17 Eg. An apparatus for reproducing speech, music or the like sounds from vibrations recorded on a film, comprising a photoelectric cell, means for imparting to the film a rapid and uniform motion longitudinally of the film past said cell, a source of light projection for providing a line of light in fixed position, and an objective lens in the neighborhood of the area of translation on the film but spaced therefrom for collecting said projected light and directing the same as a converged narrow line extending transversely of the direction of movement of the film and passing through the area of translation on the film and to said cell.

H²

13 Eg. An apparatus for reproducing speech, music or the like sounds from vibrations recorded on a film, by the use of a line of light varied in accordance with the sound, comprising a photoelectric cell, means for imparting to the film a rapid and uniform motion longitudinally of the film past said cell, a source of light projection for providing said light, and an objective lens in the path of said light and spaced from the film for directing said light as a converging narrow line impinging on the film at a point in the region of the focal point of said lens, said light passing through the film and on to said cell, the space between said lens and the film being free of obstructions to said light.

all J'

J' (Cls. 14-15) Fole

REMARKS

The new claims have been added to more fully cover various phases of applicants' invention as disclosed in this early application. The amendment to the specification has been added to more clearly state the substance found in the original specification, page 4, lines 19 to 22, and page 6, lines 13 to 16, and elsewhere in the original specification, such disclosures being particularly pertinent to the new claims.

Applicants will provide a clean new copy of the specification if the Examiner so desires.

Claim 11 defines sound translation apparatus comprising means for rapidly and uniformly moving the film in combination with means for collecting and projecting through an object glass a converged narrow line of light, which impinges directly upon the film without the necessity of using any intervening slit to produce such narrow line. This elimination of the use of a slit adjacent the film avoids the necessity for using a narrow accurately made or adjusted slit, inasmuch as a line source of light is used which may be of relatively larger dimensions, and the resulting line of light is converged to the desired narrow width at the point where it impinges upon the film. This not only involves a substantial improvement over the use of the slit adjacent the film, eliminating certain optical disadvantages of the slit and the liability of the slit to become clogged with dust or other foreign matter in its position adjacent the rapidly moving film, but also eliminates any necessity for devices between the object glass and the film which might interfere with its accurately

uniform high speed of movement, as well as being difficult to adjust.

This combination is clearly novel and patentable over the prior art.

New claim 12 is similar to claim 11, except that in claim 12 the narrow line of light is recited as impinging upon the film at a point in the neighborhood of the focal point of the object lens, as is apparent from the drawings, whereby a reduced clearly defined image of the narrow line source of light is provided.

New claims 13 and 14 respectively are analogous to claims 11 and 12, except that claims 13 and 14 are directed to the reproducing means including in the combination the photoelectric cell which is capable of responding without inertia and with a high degree of accuracy to the exceedingly rapid and complex sound variations corresponding to speech.

Allowance of the application in its present form is respectfully urged.

Respectfully submitted,

Ward & Cole

Attorneys for applicants.

Div. 5 Room 108 Annex

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

Paper No. 28

All communications concerning this application should give the serial number, date of filing, and name of the applicant

CJ/GD Feb. 27, 1929

Please find below a communication from the EXAMINER in charge of this application.

Thomas E. Robertson
Commissioner of Patents.

GPO 11—8023

Ward & Crosby
233 Broadway
New York, N. Y.

Applicant: Hans Vogt et al

Ser. No. 545,377
Filed Mar. 20, 1922
For Device for Phonographs with Linea-Phonogram Carriers

Responsive to Amendment G filed May 3, 1928, and Amendment H filed December 6, 1928.

Page 2, line 19, "mass momentum" is deemed inaccurate since momentum is a property a body possesses by reason of its motion, and is not inherent in the body itself.

Page 3, line 7, "tone record" should be sound record.

The reference characters used on the drawings and in the specification are not consistent. Like parts should be represented by like reference characters throughout the specification and drawings.

The claims are deemed allowable.

C.L.J.

J. F. MacNab
Examiner.

545377-83

90

RECEIVED

MAR 1 1929

Division 5, Paper No. 29

Letter to office.

4 Prints

APPLICATION FILED MAR 1 1929 U.S. PATENT OFFICE

IN THE UNITED STATES PATENT OFFICE

Div. 5 Room 108 Annex

In re Application of
Hans Vogt, et al,
Ser. No. 545,377,
Filed March 20, 1923,
For Device for Phonographs
with Linear Phonogram Carriers

ACCOUNT

New York, N.Y. February 28, 1929

Hon. Commissioner of Patents
Washington, D.C.

S i r :

It is respectfully requested that the Examiner have the Official Draftsman make the following changes in the reference characters on the drawings, the same being indicated in ink on the attached photostat:

Figs. 3 and 4, in each instance, change "h" to -h'- change "g" to - f-; change "n" to- e-; change "o" to - t -; change "k" to - z -.

Fig. 6 change "h" to -h'-; "k" to -z-; "o" to -t-; "n" to- e-; "g" to -f-.

OK C.J. 3/7/29

RECEIVED IN DIV. C MAR 13 1929

Respectfully submitted

Attorneys for Applicants

CORRECTION ORDERED DIV. C CORRECTED

MAR 18 1929 MAR 18 1929

50¢ ACCOUNT

545377

545377

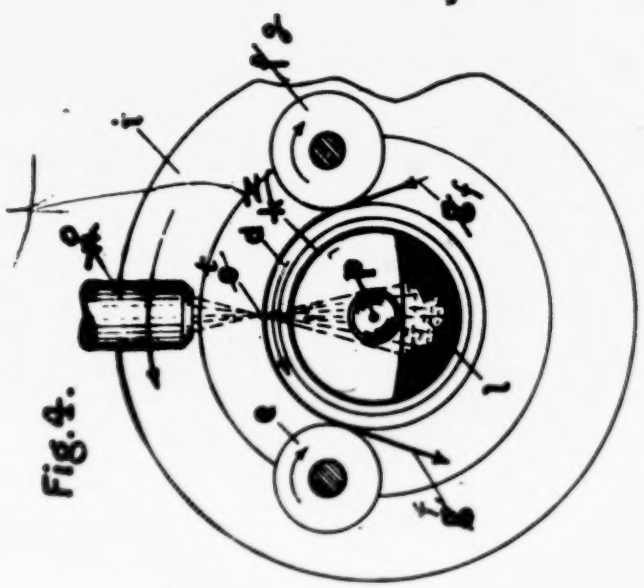


Fig.4.

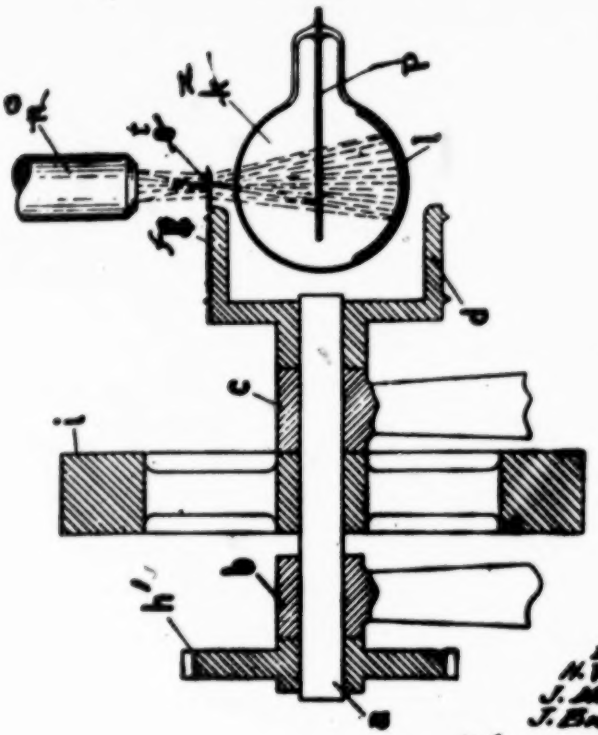


Fig.3

Inventors
M. Vogl
J. Mikrolla
J. Bugl.
by Munn & Co
545377-98

545377

Fig. 6.

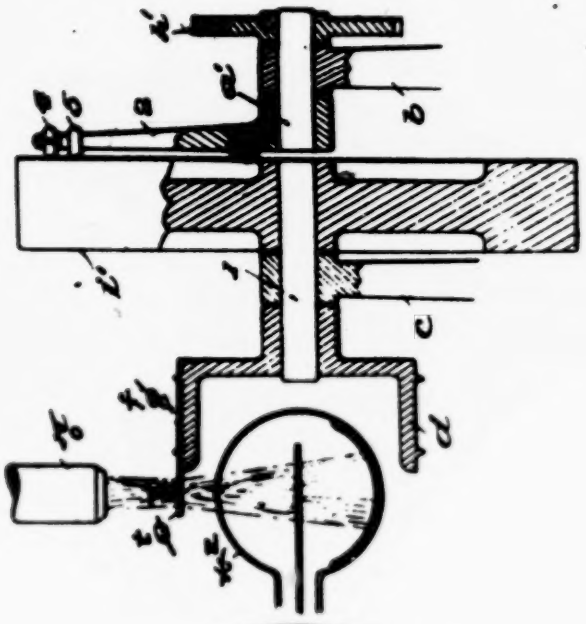
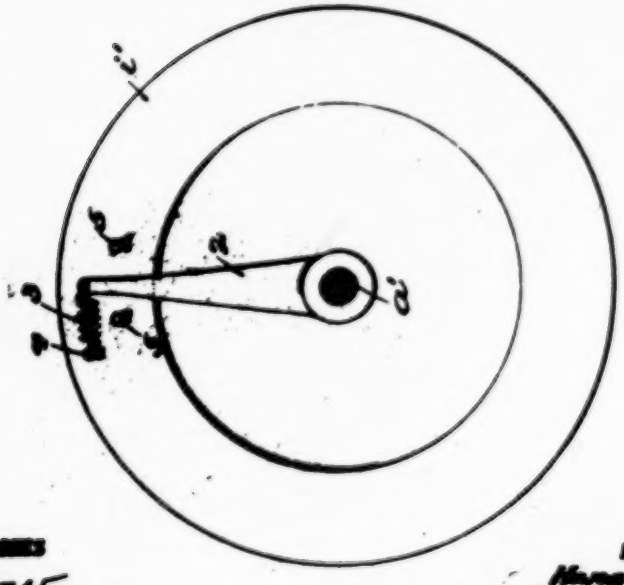


Fig. 5.



WITNESSES

INVENTORS
Hans Vogt
Joseph Klapsella
BY Josef Engl

ATTORNEYS

545377-86

RECEIVED
MAR 6 1929
Division 5, Paper No. 34
Amendment - D
3340

IN THE UNITED STATES PATENT OFFICE

In re application of HANS VOGT, et al.,
Ser. No. 545,377,
Filed March 20, 1922,
For Device for Phonographs with Linear Phonogram Carriers.
Div. 5, Room 108 Annex.

New York, N. Y.,
March 5, 1929

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

In response to the Office action of February 27, 1929, kindly amend the above entitled application as follows:

In the specification, page 2, line 19, after "momentum" insert a comma, and also insert --when the desired velocity is imparted thereto, --. Line 24 before "record" insert -- portion of the --. Same line cancel "in action" and substitute -- active --. Next to last line insert a comma after "forth".

Page 3, line 7, change "tone" to -- sound --.

Page 3, line 14, insert the following paragraphs:

545377-29

Also, according to the present invention a dependable and highly efficient optical system is provided for use in conjunction with moving film strips of the above indicated character.

Various further and also various more specific objects, features and advantages will more clearly appear from the detailed description given below taken in connection with the accompanying drawings, which form a part of this specification.

The invention consists in such novel features, arrangements and combinations of parts and methods as may be shown, described and claimed in connection with the embodiments of the invention herein disclosed by way of example only.

Page 3, line 23, cancel "the" and after "masses" insert - as at -.

Page 5, line 5, before "further" insert - a -. Line 17 change "g" to - f -. Line 20 change "f" to - g -.

In the amendment to page 5, lines 21 and 22, as submitted March 23, 1925, change reference character "h" to - h' -. (It is thought that this amendment may be more conveniently inserted without rewriting the previous insertion as would ordinarily be done).

Page 5, line 27, change "f" to - g - in both instances.

Page 5 in the amendment inserted at the end of the page under date of March 23, 1925, change "f" to - g -.

Page 6, in the amendment to lines 1 to 12 as submitted March 23, 1925, the reference character "f" should be changed to - f - (see page 3, line 22, of the amendment dated March 23, 1925). Also in the same amendment page 3, line 25, change "f" to - f- in both instances.

In the same amendment of March 23, 1925, page 4, line 6, the reference character "k" should be changed to -z-. Also in said same amendment page 4, line 16, change the comma to a period and in line 17 change "in" to -In-. In the same line change "to the" to - there is-. Same line change "it" to - the film -, and in line 18 cancel "(other)".

In the original specification page 6, lines 13 to 16, as amended March 23, 1925, the reference character "n" should be changed to -g-.

In the original specification page 6, line 17 change "k" to - z-.

In the amendment dated December 3, 1928, (in the insert to page 6, line 21,) the reference character "n" should be changed to - g-.

In the amendment to page 6, lines 22 to 24, as submitted March 23, 1925, "cell k" should be - cell z -.

In the original specification page 7 before "We claim" insert the following paragraph :

"While the invention has been described in detail with respect to certain particular preferred examples which give satisfactory results, it will be understood by those skilled in the art after understanding the

invention that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended therefore in the appended claims to cover all such changes and modifications.-

In the amendment dated December 5, 1928, (in the page 6, insert at line 21,) after the words "area of translation" insert -t-.

In the original specification, page 4, line 18, insert the following:

That is, the spring pressed rollers engaging the film at points between the feeding rollers and the fly wheel roller, thus exert resilient pressure against the film to force the film into effective engagement with the fly wheel and thereby at the same time the film is deflected from a straight line position, the extent of such deflection varying slightly with any irregularities in the movement of the film and its resulting tension, with the result that any such irregularities are effectively prevented from being imparted to the film at the point of translation.

545377-90

3344

REMARKS

With the correction of the above alleged informalities, in accordance with the Examiner's request, it is believed that the case is in condition for immediate allowance, as understood from the recent conference with the Examiner.

The use of a double set of reference characters arose from the fact that this application was filed under the convention as embodying the disclosures of several foreign applications and, inasmuch as this application was prepared abroad, it was not appreciated that the reference characters of the drawings could have been revised without interfering with the proper procedure under the international convention. A letter of instructions regarding the alteration of the reference characters is attached hereto.

Respectfully submitted

Attorneys for Applicants

545377-91

31

3345

APPLIED FOR MAR 6 1929 U.S. PATENT OFFICE

IN THE UNITED STATES PATENT OFFICE

In re application of HANS VOGT, et al.,

Ser. No. 545,377,

Filed March 20, 1922,

For Device for Phonographs with Linear Phonogram Carriers.

Div. 5, Room 108 Annex.

New York, N.Y.,

March 5, 1929.

Hon. Commissioner of Patents,

Washington, D. C.

Sir:

Supplementing the amendment filed substantially concurrently herewith for the purpose of correcting informalities, kindly add the following new claims:

Insert 2

14. A constant speed film feeding mechanism, comprising a continuously rotating feeding roller, a fly wheel, over which the film passes and which roller is a roller/operatively connected to said fly wheel, and means to compensate for variations in the motion of the film arising from small irregularities in the motion of the film as fed by said feeding roller.

Insert 3

15. A constant speed film feeding mechanism, comprising a continuously rotating feeding roller, a fly wheel, over which the film passes and which roller is a roller/operatively connected to said fly wheel, means to compensate for variations in the motion of the film arising from small irregularities in the motion of the film as fed by said feeding roller, said compensating means including a spring pressed roller engaging the film at a point between

545377-98

said feeding roller and said fly wheel roller with a resilient pressure causing the film to be deflected a variable amount in passing over said spring pressed roller, the extent of such deflection varying in accordance with said irregularities of motion.

Insert H

17. A constant speed film feeding mechanism, comprising a continuously rotating feeding roller, a fly wheel a roller over which the film passes and which roller is operatively connected to said fly wheel, means to compensate for variations in the motion of the film arising from small irregularities in the motion of the film as fed by said feeding roller, said compensating means including a member yieldingly pressing against the film at a point between said feeding roller and said fly wheel roller to variably deflect the film from a straight line path at such point.

per H

18. Apparatus for translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound, comprising means for advancing the film with substantially uniform motion longitudinally of the film, past the point of translation, supporting means engaging the film during its passage past the point of translation, and means acting against the film in a direction substantially transversely thereof with resilient pressure to force the film into such engagement and to effectively eliminate small irregularities in the movement of the film.

545377-93

3347

17~~9~~. In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of means for supporting and progressing the elongated carrier from one point to another point, and past an intermediate point at which the record is made on the carrier in recording or from which the record is taken from the carrier in reproducing, including a cylinder over a portion of the periphery of which the carrier passes adjacent to said intermediate point, a fly wheel operatively associated with said cylinder, said carrier progressing means operating to advance the carrier past said intermediate point at uniform speed under the control of said fly wheel.

g'

18~~9~~. The method of translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound, comprising rapidly advancing the film past the point of translation, and subjecting the motion of the film in passing said point, to the control of inertia means to effectively eliminate irregularities in the movement of the film.

use O'

O'(Cl. 9) Folo

545677-98

3348

REMARKS

New claims 15, 16, and 17 have been added to more fully protect that phase of applicants' invention relating to means for eliminating the effect of minor irregularities in the driving of the film, such means being indicated for example, in Fig. 2, at drl. Of course, it is understood that similar spring pressed rollers may be applied to the embodiments shown in the various other figures, and for a like purpose.

New claim 18 has been inserted to more fully protect that phase of applicants' invention relative to the use of resilient means pressing the film into engagement with the driving means or other supportive means at the point of sound translation, for the elimination of the effect of small irregularities in the movement of the film.

New claim 19 has been added along the lines of allowed claim 1, except that the last lines of the claim have been changed to more fully protect the invention.

New claim 20 has been inserted to cover applicants' invention as relates to the method involved in the use of all the various embodiments of the apparatus disclosed. It is apparent that the substance of all these new claims is novel and that the prior art is impertinent thereto.

Respectfully submitted,

Attorneys for Applicants

APPLICATION DIV. MAR 8 1929 PATENT OFFICE

Exhibit No. 32

IN THE UNITED STATES PATENT OFFICE. 3349

In re application of HANS VOGT, et al.

Ser. No. 545,377,

Filed March 20, 1922,

For Device for Phonographs with Linear Phonogram Carriers,

Div. 5, Room 108 Annex.

March 7, 1929.

Hon. Commissioner of Patents,

Washington, D. C.

Sir:-

Supplementing the amendments recently filed, kindly amend the above entitled application as follows:-

In the specification, at the end of the brief description of Figure 5, cancel the period and add adaptable to the rear side of the fly wheels, the face views of which are shown in various of the other figures. (The brief description of Figure 5 is found on page 1 of the amendment filed May 25, 1923 and it is believed that the above change may be more conveniently made to that amendment than by rewriting the whole insert).

Prefix claim 15 with the following:-
combination, optical means
In ~~apparatus~~, for translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound,

Prefix claim 16 with the following:-
combination, optical means
In apparatus, for translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound,

545377-96

3350

Prefix claim 17 with the following:-

combination, optical means

In ~~apparatus~~, for translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound,

Cancel claim 18 without prejudice to the scope of the remaining claims.

R E M A R K S .

The specification has been amended to point out that the fly wheels of the various embodiments shown (including that of Figure 2, for example) may be driven by the arrangement shown in Figure 5. Of course it would have been confusing to have attempted to show the driving means for the fly wheels in Figures 1 and 2, inasmuch as these Figures show face views of the fly wheels, whereas the driving means is most conveniently located on the rear side of the fly wheels.

Claims 15, 16 and 17 have been amended so that these claims are now specifically directed to sound film records. These amendments have been made in order to expedite the prosecution of the application by rendering it unnecessary for the Examiner to conduct a further search in unrelated arts before final action on the application.

In reference to claim 19, it is submitted that no further search will be necessary in view of the allowance of claim 1, since these claims differ only in the last three lines, the language of the last part of claim 19 having been revised to more tersely bring out the patentable merits of claim 1, and avoiding any unnecessary implication as to the means for rotating the fly wheel cylinder.

In connection with claim 20, in compliance with the Examiner's suggestion it is here pointed out that the words

545377-37

"inertia means" have reference to the fly wheel or equivalent means for controlling the film in passing the point of translation. The film, of course, having inconsiderable mass of itself has substantially no inertia.

Respectfully submitted,

Woodward & Corby
Attorneys for Applicant.

545377-98

MAIL DIVISION
MAR 12 29
U.S. PATENT OFFICE

Paper No. 34
Amendment L

UNITED STATES PATENT OFFICE 3352

In re application of HANS VOGT, et al
Ser. No. 545,377
Filed Mar. 20, 1922,
For Device for Phonographs with Linear Phonogram Carriers.
Div. 5, Room 108 Annex.

New York, N.Y.,
March 11, 1929.

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

In response to the Office action of February 27, 1929, kindly amend the above entitled application as follows:

In the specification, page 2, lines 19 and 20, cancel the inserts and also cancel the word "mass" before "momentum".

Page 6, after the insert to line 21, insert the following: -- Certain features of this type of optical system are also disclosed in our patent No. 1,590,185, issued June 29, 1926, application for which was filed on April 4, 1921, and the claims of which patent relate to divisional subject matter. --

37 fols

REMARKS

The above amendment to page 2 of the specification was made in accordance with the Examiner's oral request, as made at a recent interview courteously granted applicants' attorneys. It is understood that this places the application in condition for immediate allowance.

The amendment to page 6 is made in view of Rule 43.

Respectfully submitted,

Attorneys for Applicants

RECEIVED
MAR 2 1 1929
Division 5. Paper No. 35
Amendment M

IN THE UNITED STATES PATENT OFFICE

In re application of :
HANS VOGT, et al, :
Serial No. 545,377, : Division 5,
Filed March 20, 1922, : Room 108-A
For Device for Phonographs:
with Linear Phonogram :
Carriers. :

Hon. Commissioner of Patents,
Washington, D.C.

Sir:

Kindly amend the above entitled application as follows:

At the end of ~~page 2, line 19;~~ line 19, page 2.
insert the following: --when the desired velocity is imparted thereto--

REMARKS.

The above amendment is made in compliance with a suggestion made by the Examiner at a conference and the case is now in condition for allowance.

Prompt issuance of the notice of allowance is respectfully solicited.

Respectfully submitted,
Hans Vogt, et al,
By Ward & Crosby
~~Attorneys. Crosby~~ & Neal.

108

RMS - Div. 5.
ADDRESS ONLY
THE COMMISSIONER OF PATENTS
WASHINGTON, D. C.

121

Serial No. 545,377

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

March 25, 1929

Hans Vogt, Joseph Massolle & Josef Engl, Assors.

Your APPLICATION for a patent for an IMPROVEMENT in Device for Phonographs With Linear Phonogram Carriers filed Mar. 20, 1928 has been examined and ALLOWED with 18 claims.

The final fee, TWENTY DOLLARS, WITH $1 ADDITIONAL FOR EACH CLAIM ALLOWED IN EXCESS OF 20, must be paid not later than SIX MONTHS from the date of this present notice of allowance. If the final fee be not paid within that period, the patent will be withheld, but the application may be renewed within one year after the date of the original notice with a renewal fee of $20 and $1 additional for each claim in excess of 20.

The office delivers patents upon the day of their date, on which date their term begins to run. The preparation of the patent for final signing and sealing will require about four weeks, and such work will not be begun until after payment of the necessary final fee.

When the final fee is paid, there should also be sent, DISTINCTLY AND PLAINLY WRITTEN, the name of the INVENTOR, TITLE OF THE INVENTION, AND SERIAL NUMBER AS ABOVE GIVEN, DATE OF ALLOWANCE (which is the date of this circular), DATE OF FILING, and, if assigned, the NAMES OF THE ASSIGNEES.

If it is desired to have the patent issue to an ASSIGNEE OR ASSIGNEES, an assignment containing a REQUEST to that effect, together with the FEE for recording the same, must be filed in this office on or before the date of payment of the final fee.

After issue of the patent, uncertified copies of the drawings and specifications may be purchased at the price of TEN CENTS EACH. The money should accompany the order. Postage stamps will not be received.

The final fee will NOT be received from other than the applicant, his assignee or attorney, or a party in interest as shown by the records of the Patent Office.

NOTICE.—WHEN THE NUMBER OF CLAIMS ALLOWED IS IN EXCESS OF 20, NO SUM LESS THAN $20 PLUS $1 ADDITIONAL FOR EACH CLAIM IN EXCESS OF TWENTY CAN BE ACCEPTED AS THE FINAL FEE.

Respectfully,

Thomas E. Robertson
Commissioner of Patents.

Ward & Crosby
255 Broadway
New York, N. Y.

545377-104

UNCERTIFIED CHECKS WILL NOT BE ACCEPTED.

BE SURE IN REMITTING THE FINAL FEE GIVE THE SERIAL NUMBER AT THE HEAD OF THIS NOTICE.

RECEIVED
APR 10 1929
Division 5, Paper No. 37

Petition (78) &
Amdt. N
(not cited)

UNITED STATES PATENT OFFICE

In re application of HANS VOGT, et al.,
Ser. No. 545,377,
Filed Mar. 20, 1922,
For Device for Phonographs with Linear Phonogram Carriers.
Div. 5, Room 108 Annex.

AMENDMENT UNDER RULE 78

New York, N.Y.,
March 29, 1929.

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

In accordance with the provisions of Rule 78, the final fee not having yet been paid, it is respectfully requested that the following amendment be entered.

It is assumed that the allowed claims have already been renumbered consecutively as 1 to 18.

Kindly add the following new claims:

19. In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of means for supporting and progressing the elongated carrier from one point to another point, and past an intermediate point at which the record is made on the carrier in recording or from which the record is taken from the carrier in reproducing, including a cylinder over a portion of the periphery of which the carrier passes, a fly wheel operatively associated with said cylinder, the carrier progressing means operating to advance the carrier past said intermediate point at uniform

speed under the control of said fly wheel, a supporting surface being provided for the film at said intermediate point and yielding means pressing the film into engagement with said supporting surface to cooperate with the fly wheel control in effecting uniform movement of the film.

20. The method of translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound, comprising rapidly advancing the film past the point of translation, subjecting the motion of the film in passing said point to the control of inertia means to effectively eliminate irregularities in the movement of the film, and retaining one surface of the film in contact with a supporting area at said point of translation by yieldable means engaging the other surface of the film.

REMARKS

It is submitted that these new claims may be allowed forthwith inasmuchas they include the patentable substance and practically the same terminology respectively of claims 17 and 18, plus the feature shown in Fig. 2 for example, including the yielding means for urging the film into contact with a supporting surface at the point of translation. Several claims of different scope have already been allowed to this spring control means. The new claims are merely intended to insure applicants' greater protection as to the control by the combined inertia means and yielding means. In view of the scope of the claims already allowed covering these features independently, obviously no new search will be necessary in the allowance

of these claims.

Respectfully submitted,

Ward & Worley

Ward Worley & Neal

Attorneys for Applicants

118 No. 5 Room 108 Annex

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

Paper No. 38

All communications regarding this application should give the serial number, date of filing, and name of the applicant

CJ/S

April 3, 1929.

Applicant: Hans Vogt, et al.

Ser. No. 545,377
Filed March 20, 1928
For A Device for Phonographs With Linear Phonogram Carriers.

Ward & Crosby,
253 Broadway,
New York, N. Y.

The entry of the amendment proposed under Rule 78 has been disapproved. A copy of the examiner's adverse report appears below.

Thomas E. Robertson
Commissioner of Patents.

It is recommended that this amendment containing additional claims 19 and 20 be not permitted for the following reasons:

Both claims bring in additional subject matter which is not supported in the disclosure. A "supporting surface at the point of translation" is not disclosed. A yieldable means pressing the film in contact with the support at the point of translation is also not disclosed.

In claim 19 the same structure for performing the same function is claimed twice. In lines 3 to 5 "means for supporting and progressing the elongated carrier from one point to another" and in lines 12 to 14 "a supporting surface being provided for the film at said intermediate point".

C.L.J.

J. F. MacNab.
Examiner.

APPROVED

APR 4 - 1929

AS'T COMMISSIONER OF PATENTS.

545877-109

APPLICATION DEPT. APR 10 1929 U.S. PATENT OFFICE

ISSUE DIVISION APR 10 1929 U.S. PATENT OFFICE

3354 RECEIVED APR 11 1929

UNITED STATES PATENT OFFICE

Division 5, Paper No. 34
Petition (78) & Amdt. D.

In re application of HANS VOGT, et al.,
Ser. No. 545,377,
Filed March 20, 1922,
For A Device for Phonographs with Linear Phonogram Carriers.
Div. 5, Room 108 Annex.

SUBSTITUTE AMENDMENT UNDER RULE 78.

New York, N.Y.,
April 9, 1929.

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

In view of the Examiner's objections to the amendment hereto dated as of March 29, 1929, it is respectfully requested that said amendment be returned to applicant's attorneys and that the following claim be added in lieu of claims 19 and 20, as formerly proposed:

19. The method according to claim 18, and in which the film is yieldingly pressed into contact with a supporting area immediately adjacent the point of translation, such pressure cooperating with the inertia control in the elimination of irregularities in the film motion.

Sig

ENTRY RECOMMENDED.
UNDER RULE 78.

J. F. MacNab
EXAMINER.

ENTRY APPROVED

ACTING COMMISSIONER OF PATENTS

545377-111

REMARKS

This new claim clearly eliminates the criticisms raised by the Examiner in connection with the previous proposed amendment under Rule 78.

Since this new claim incorporates by reference the entire subject matter of allowed claim 18, obviously no new search is required to determine the patentability thereof and it is submitted that a mere inspection of Fig. 2 of the drawings for example, will reveal that the added subject matter of this claim is clearly within the original disclosure. That is, from Fig. 2 it is apparent that the film is pressed into contact with the film supporting surface area of the roller R by the yieldingly mounted members dr1 and dr2.

In the original specification, page 4, lines 15 and 18, the subject matter of this new claim is clearly set forth and explained in connection with Fig. 2.

In view of the importance of the feature of this new claim from a practical standpoint, applicants' attorneys feel obliged to submit the same for the Examiner's consideration and allowance, although the necessity for the Examiner's again considering this case is sincerely regretted. It is believed, however, that the matter may be much more conveniently and expeditiously disposed of in this manner, than by forfeiture and renewal proceedings.

Applicants are ready to immediately pay the final fee upon allowance of this claim, which action is respectfully urged at an early date.

Respectfully submitted,

ward + brady
ward brady & neal

Attorneys for Applicants.

116

Div. 5 Room 108 Annex

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name

CJ/S

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

Paper No. 40

All communications respecting this application should give the serial number, date of filing, and name of the applicant

April 18, 1929.

Ward, Crosby & Neal,
233 Broadway,
New York, N. Y.

Applicant: Hans Vogt et al.

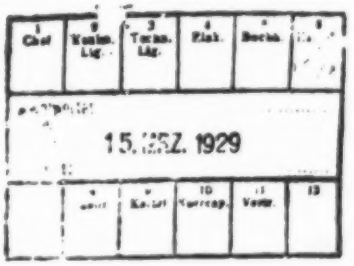
Ser. No. 545,377
Filed Mar. 20, 1922
For Device for Phonographs With Linear Phonogram Carriers.

The amendment proposed has been entered under Rule 78.

Thomas E. Robertson

Commissioner of Patents.

545877-114



Paper 41

ISSUE DIVISION

APR 25 1929

U. S. PATENT OFFICE

UNITED STATES PATENT OFFICE

In re application of JOSEF ENGL, JOSEPH MASSOLLE and HANS VOGT,

Serial No. 545,377,

Filed March 20, 1922,

For Device for Phonographs with Linear Phonogram Carriers.

Div. 23, Room 217.

726

May 2

SUPPLEMENTAL OATH

Consular Control of the United States of America)
City of BERLIN Empire of Germany) ss:

HANS VOGT, one of the joint applicants of the above entitled application, being duly sworn, deposes and says that he has read the claims of the above entitled application as amended by various amendments heretofore made and inclusive of the amendment dated December 5, 1928, and including the new claims then submitted, and understands the contents of the same; that the subject matter of said amendments, including the subject matter of all of the claims now pending in this application, was invented by himself jointly with Josef Engl and Joseph Massolle, before the filing of the above entitled application and before the filing of any of the corresponding German applications as recited in the oath of the above entitled application; was not known or used before the invention of the same by applicants, was not patented or described in a printed publication in any country more than two years before the filing of the above entitled application or before the filing of any of applicants' said corresponding German applications, was not patented in a foreign country on an application filed by applicants or their legal representatives or assigns more than twelve months before the above entitled application, was not in public use or on sale in the United States for more than two years before the above entitled application or before the filing of any of said corresponding German applications; and that the said subject matter of invention has not been abandoned.

Hans Vogt

Subscribed and sworn to before me this 17 day of May, 1929.

CYRUS B. POLLOCK
Vice Consul of the United States of America

SERVICE No. 3638

545377-18

$2.-

Paper 41

APR 28 1...

U. S. PATENT ...

UNITED STATES PATENT OFFICE

In re application of JOSEF ENGL, JOSEPH MASSOLLE and HANS VOGT,

Serial No. 545,377,

Filed March 20, 1922,

For Device for Phonographs with Linear Phonogram Carriers.

Div. 23, Room 217.

226
May 21

SUPPLEMENTAL OATH

Consulate General of the United States of America
City of BERLIN Empire of Germany } ss:

JOSEPH MASSOLLE, one of the joint applicants of the above entitled application, being duly sworn, deposes and says that he has read the claims of the above entitled application as amended by various amendments heretofore made and inclusive of the amendment dated December 5, 1928; and including the new claims then submitted, and understands the contents of the same; that the subject matter of said amendments, including the subject matter of all of the claims now pending in this application, was invented by himself jointly with Josef Engl and Hans Vogt, before the filing of the above entitled application and before the filing of any of the corresponding German applications as recited in the oath of the above entitled application; was not known or used before the invention of the same by applicants, was not patented or described in a printed publication in any country more than two years before the filing of the above entitled application or before the filing of any of applicants' said corresponding German applications, was not patented in a foreign country on an application filed by applicants or their legal representatives or assigns more than twelve months before the above entitled application, was not in public use or on sale in the United States for more than two years before the above entitled application or before the filing of any of said corresponding German Applications; and that the said subject matter of invention has not been abandoned.

x Joseph Massolle

Subscribed and sworn to before me this 16th day of March, 1929.

CYRUS B. POLLMER
Vice Consul of the United States of America

SERVICE No. 3562

545377-116

APPLICATION SECTION APR 1 1929 PATENT OFFICE

UNITED STATES PATENT OFFICE

In re application of JOSEF ENGL, JOSEPH MASSOLLE and HANS VOGT,

Serial No. 545,377,

Filed March 20, 1922,

For Device for Phonographs with Linear Phonogram Carriers.

Div. 23, Room 217.

7.26
May 24

SUPPLEMENTAL OATH

Consulate General of the United States of America
City of BERLIN Empire of Germany } ss:

JOSEF ENGL, one of the joint applicants of the above entitled application, being duly sworn, deposes and says that he has read the claims of the above entitled application as amended by various amendments heretofore made and inclusive of the amendment dated December 5, 1928, and including the new claims then submitted, and understands the contents of the same; that the subject matter of said amendments, including the subject matter of all of the claims now pending in this application, was invented by himself jointly with Joseph Massolle and Hans Vogt, before the filing of the above entitled application and before the filing of any of the corresponding German applications as recited in the oath of the above entitled application; was not known or used before the invention of the same by applicants, was not patented or described in a printed publication in any country more than two years before the filing of the above entitled application or before the filing of any of applicants' said corresponding German applications, was not patented in a foreign country on an application filed by applicants or their legal representatives or assigns more than twelve months before the above entitled application, was not in public use or on sale in the United States for more than two years before the above entitled application or before the filing of any of said corresponding German applications; and that the said subject matter of invention has not been abandoned.

Josef Engl.

Subscribed and sworn to before me this 16 day of March, 1929.

Cyrus B. Follmer

CYRUS B. FOLLMER
Vice Consul of the United States of America

SERVICE No. 3573.

545377-119

MAIL DIVISION
MAY 29 29
U.S PATENT OFFICE

UNITED STATES PATENT OFFICE

In re application of JOSEF ENGL, JOSEPH MASSOLLE and HANS VOGT,

Serial No. 545,377,

Filed March 20, 1922,

For Device for Phonographs with Linear Phonogram Carriers.

Div. 23, Room 217.

Patent No. 1,713,726, dated May 21, 1929.

New York, N.Y.,
May 27, 1929.

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

Kindly issue a certificate of correction in the above entitled case showing the following printer's errors:

Page 1, lines 25 and 26, "when the desired velocity is imparted thereto" was cancelled by amendment dated March 11, 1929.

Page 2, line 6, "as" should be - is -. (See correction of amendment dated March 23, 1925.)

Page 2, line 9, "or" should be - on -. (See amendment dated March 23, 1925.)

Page 2, line 16, "roller" should be - sprocket -. (See amendment dated March 23, 1925.)

Page 2, line 28, "with" should be - the -, as in original specification.

Claim 8, line 113, "position" should be - portion -. (See amendment dated May 2, 1928, under claim 9.)

Respectfully submitted,

545877-119

APPROVED for correction of errors on pages 2 and 4.
JUN 22 1929
COMMISSIONER OF PATENTS

ABS

ADDRESS ONLY
THE COMMISSIONER OF PATENTS
WASHINGTON, D. C.

LETTER No. 118623 43

DEPARTMENT OF COMMERCE

UNITED STATES PATENT OFFICE

WASHINGTON

June 10, 1929.

In the matter of
Letters Patent No. 1,713,726,
Hans Vogt and J. Massolle and J. Engl,
May 21, 1929,
Ward and Crosby, attorneys.

REPORT OF THE CHIEF OF THE ISSUE AND GAZETTE DIVISION.

Attorneys return Letters Patent requesting that a certificate be issued correcting the errors as set forth in the accompanying letter.

With respect to the first alleged error, the Printer evidently, followed copy as passed for issue by the Examiner. (The applicant, is evidently, at fault) The second error, evidently, arose from the incorrect entry of portion of Amendment C, paper #16. The errors on page 2, lines 9 and 16, are referred to the Examiner for report. The error on page 2, line 28, is chargeable to the Printer. The error in Claim 8, line 113, is chargeable to the Printer.

Respectfully,

Acting Chief of the Issue Division.

To Division 5 for report.

REPORT OF DIVISION 5

The statement of the Acting Chief of the Issue Division is correct except as to the errors on page 2, lines 9 and 16 of the patent, of which he did not treat. As regards the first alleged error the clause mentioned was reinserted by amendment M paper No. 35, therefore no error occurred.

The third error occurred by inadvertance in the entry of a portion of Amendment C, paper No. 16.

The fourth error occurred by the inadvertant omission of a portion of amendment C paper No. 16.

Respectfully,

J. F. MacNab.
Chief of Division 5

To Commissioner of Patents.

545377—120

JRS 44

ADDRESS ONLY
THE COMMISSIONER OF PATENTS,
WASHINGTON, D. C.

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

PATENT OFFICE
1929

June 20, 1929.

In re Patent No. 1,713,726, :
Hans Vogt et al., Assors., : Request for Certificate of
May 21, 1929, : Correction.
Device for Phonographs etc. :

It is regretted that the errors mentioned have occurred and a certificate of correction will be issued to correct those appearing on pages 2 and 4.

The cancellation of the words "when the desired velocity is imparted thereto" from lines 25 and 25, page 1, cannot be included in the certificate of correction because while these words were cancelled by the amendment dated March 11, 1929, they were restored by the amendment filed March 23, 1929, (dated March 21, 1929). The patent therefore agrees with the record in this respect.

THOMAS E. ROBERTSON,
Commissioner.
By T. A. Hostetler,
Solicitor.

Messrs. Ward, Crosby and Neal,
233 Broadway,
New York, N. Y.

545877-121

(Statement as to file history, Plaintiffs' Exhibit 1.)

It appears from certain parts of the file history which have been omitted by agreement of counsel as follows:

1. That the final fee was received by the Patent Office on April 20, 1929.

2. That a suit on the patent in suit was filed by the plaintiffs in the United States District Court for the District of Delaware on November 1, 1931, against Electrical Research Products, Inc.

3. That a suit on the patent in suit was filed by the plaintiffs in the United States District Court for the District of Delaware on November 20, 1931, against R.C.A. Photophone, Inc.

PLAINTIFFS' EXHIBIT NO. 1-A.

INDEX TO PLAINTIFFS' EXHIBIT 1-A.

Patents Cited During Prosecution of Application for Patent in Suit.

UNITED STATES PATENTS.

	Record Page
255,220, Wale, March 21, 1882	125
492,898, Westinghouse, March 7, 1893	129
930,605, Moore, August 10, 1909	137
1,185,056, Byron, May 30, 1916	145
1,292,448, Emory, January 28, 1919	153
1,449,327, Jaycox, et al., March 20, 1923	165

BRITISH PATENT.

19,667, Kramer, of 1912	171

FRENCH PATENTS.

414,788, Comp. Gen. de Phon., 1910	175
416,838, Martinez, 1910	183
472,467, Dragoumis, 1914	201

GERMAN PATENT.

363,640, Aftergut, 1922	209

SWISS PATENT.

85,751, Alber, 1920	219

126

(Model.)

G. WALE.

POWER INDICATOR AND RECORDER.

No. 255,220. Patented Mar. 21, 1882.

Fig. 1.

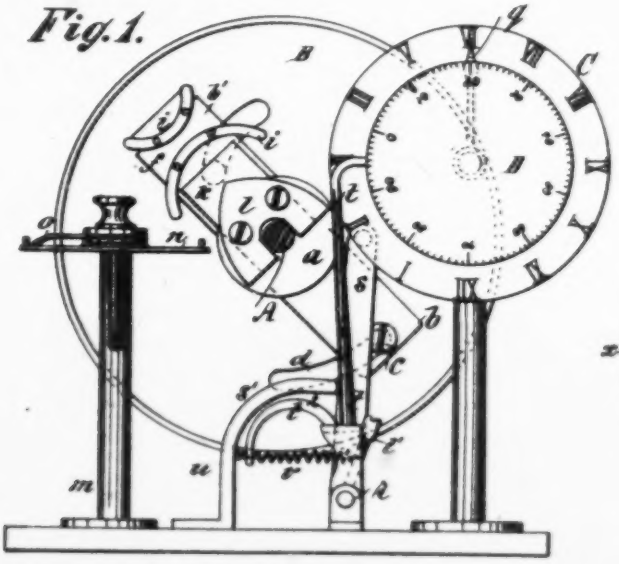


Fig. 3.

Fig. 2.

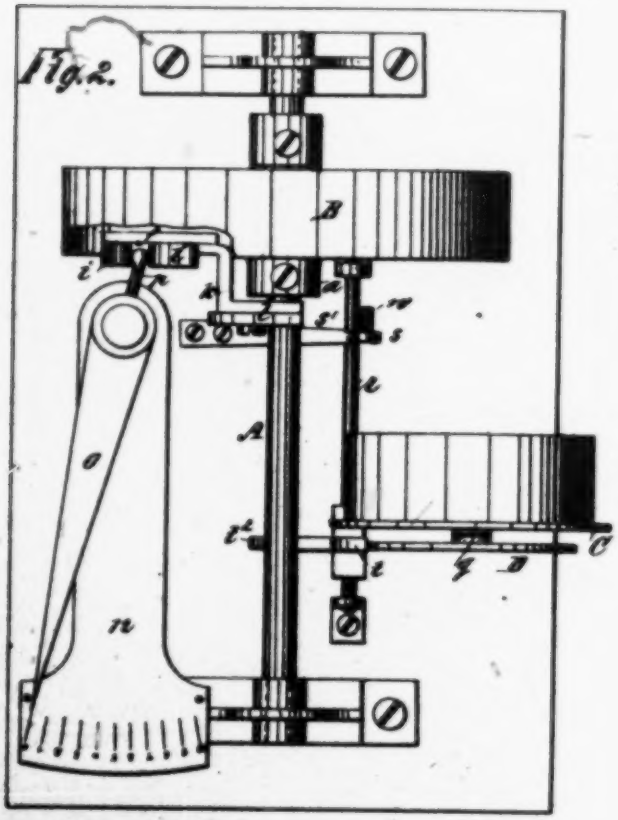


Fig. 4.

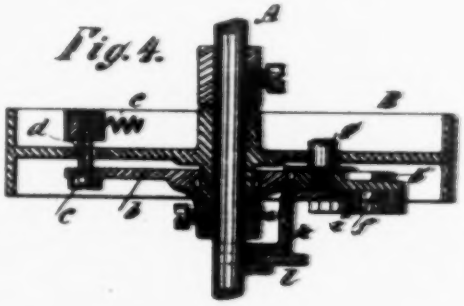
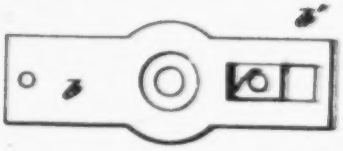


Fig. 5.



WITNESSES:

Thos. G. Wooster.

INVENTOR:

G. Wale.

BY

UNITED STATES PATENT OFFICE.

GEORGE WALE, OF PATERSON, NEW JERSEY.

POWER INDICATOR AND RECORDER.

SPECIFICATION forming part of Letters Patent No. 255,220, dated March 21, 1882.

Application filed July 12, 1881. (Model.)

To all whom it may concern:

Be it known that I, GEORGE WALE, of Paterson, in the county of Passaic and State of New Jersey, have invented a new and Improved Power Indicator and Recorder, of which the following is a specification.

The object of my invention is to obtain constant indication and permanent record of power taken from main driving-shafts.

To that end the invention consists in the combined mechanism hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a side elevation of the indicating and recording mechanism cross-sectionally of the power-shaft. Fig. 2 is a plan view of the apparatus, partially sectional. Fig. 3 is an elevation of the driving-pulley, showing the reverse side. Fig. 4 is a transverse section of the pulley on line *x x* of Fig. 3, and Fig. 5 is a side elevation of the arm by which the shaft and pulley are connected.

Similar letters of reference indicate corresponding parts.

A is a shaft, on which is a pulley, B, connected with the shaft, as next described. On the shaft A, and secured thereto by a set screw, is a collar, *a*, provided with radial arms *b b'* at opposite sides. The outer end of arm *b* is fitted with a screw or pin, *c*, which extends through a slot, *d*, formed in the web of the pulley B.

To the end of the pin *c* one end of a spiral spring, *e*, is connected, the other end of the spring being attached to the pulley, so that the spring tends to draw the pin *c* to one end of the slot. The arm *b'* is slotted and the slot fitted with a slide-piece, *f*, from which a pin, *g*, projects through a slot, *h*, formed in the web of the pulley eccentric to the axis thereof.

To the slide *f* two curved strips, *i i*, are fixed, which form eccentric flanges on the side of the slide. The slide also carries a bent arm, *k*, to the outer end of which is fixed a cam-piece, *l*.

On the post *m*, that carries a graduated dial-plate, *n*, a pointer, *o*, is hung, and from the inner end of the pointer a pin or stud, *p*, projects forth. To obtain a permanent record the following devices are employed.

C represents the dial-plate of a time-piece, and *q* the hour-hand.

D is a dial on the arbor of the hand *q*, and held thereto by friction devices of suitable character, so that the dial shall turn with the arbor.

r is a rock-shaft, sustained in suitable bearings and carrying two arms, *s t*. The arm *s* is fixed on the shaft and is sustained in an upright position, or nearly so, by a stop-piece, *s'*, against which the arm is drawn by a spring, *u*. The arm *t* is loose on the shaft and is retained in an upright position, or nearly so, by a stop-pin, *t'*, which projects from the shaft *r*, against which the arm is drawn by a spring, *v*, that extends from pin *t'* to a hook, t^2, projecting from the lower end of arm *t*. The arm *t* is curved at its upper end to bear on the edge of dial D, and in its normal position is nearly in contact with the dial. The arm *s* has a pin or lug, *w*, at its upper end projecting into the plane of the cam-piece *l*, before mentioned as being carried by the slide *f*.

The dial D is marked on its face to indicate units of power, and when set for operation the hand *q* of the time-movement will be at the zero-mark of the dial.

In operation the shaft is to be driven by power and pulley B used for connection of the machinery to be driven. The arm *b* on the shaft, acting through pin *c* and spring *e*, carries the pulley with the shaft, and the tension of the spring is sufficient to retain the pin at the end of the slot *d* so long as no power is being used. In that position of the arm *b* the slide *f* is at the inward end of the slot of arm *b'*, the cam-flanges *i* pass by the pin *p* of the pointer without contact therewith, and the cam *l* is in its inward position. If power be taken from the pulley, the resistance thereby offered will check the pulley and cause the pin *c* to move out in the slot *d* until the tension of the spring *e* is sufficient to overcome the resistance, when the pulley will revolve and the pin remain stationary in the slot. The arm *b'* at the same time car-

(Model.)

G. WALE.

POWER INDICATOR AND RECORDER.

No. 255,220. Patented Mar. 21, 1882.

Fig. 1.

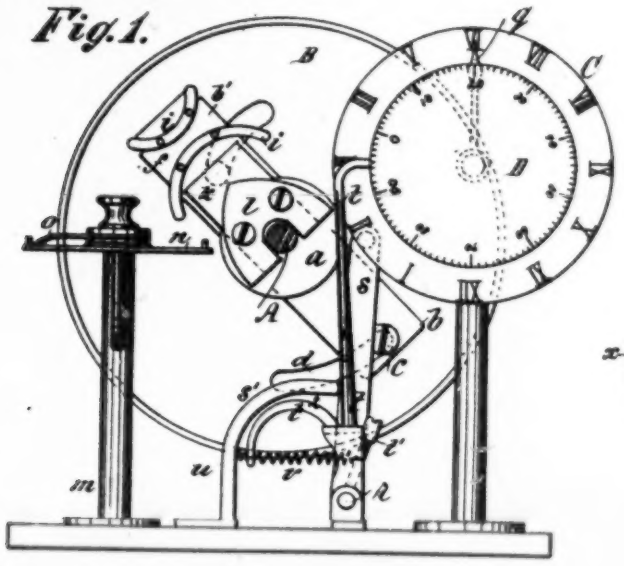


Fig. 3.

Fig. 2.

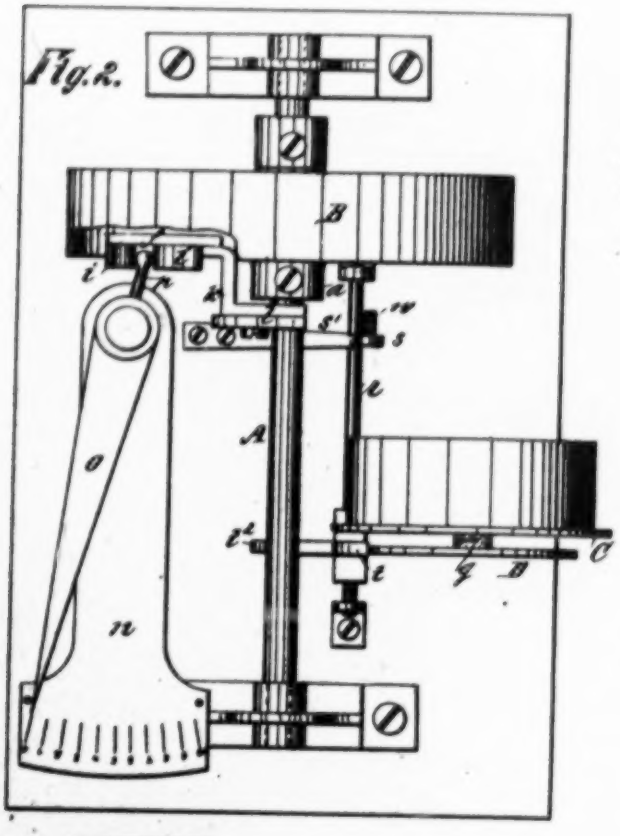


Fig. 4.

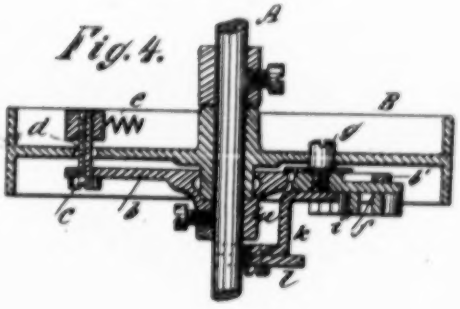
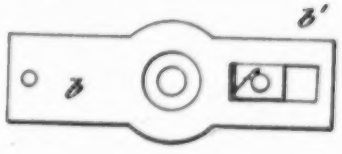


Fig. 5.



WITNESSES:

Thos. G. Webster

B. L. Underwood.

INVENTOR:

G. Wale.

BY Munn & Co

ATTORNEYS.

UNITED STATES PATENT OFFICE.

GEORGE WALE, OF PATERSON, NEW JERSEY.

POWER INDICATOR AND RECORDER.

SPECIFICATION forming part of Letters Patent No. 255,220, dated March 21, 1882.

Application filed July 12, 1881. (Model.)

To all whom it may concern:

Be it known that I, GEORGE WALE, of Paterson, in the county of Passaic and State of New Jersey, have invented a new and Improved Power Indicator and Recorder, of which the following is a specification.

The object of my invention is to obtain constant indication and permanent record of power taken from main driving-shafts.

To that end the invention consists in the combined mechanism hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a side elevation of the indicating and recording mechanism cross-sectionally of the power-shaft. Fig. 2 is a plan view of the apparatus, partially sectional. Fig. 3 is an elevation of the driving-pulley, showing the reverse side. Fig. 4 is a transverse section of the pulley on line *x x* of Fig. 3, and Fig. 5 is a side elevation of the arm by which the shaft and pulley are connected.

Similar letters of reference indicate corresponding parts.

A is a shaft, on which is a pulley, B, connected with the shaft, as next described. On the shaft A, and secured thereto by a set screw, is a collar, *a*, provided with radial arms *b b'* at opposite sides. The outer end of arm *b* is fitted with a screw or pin, *c*, which extends through a slot, *d*, formed in the web of the pulley B.

To the end of the pin *c* one end of a spiral spring, *e*, is connected, the other end of the spring being attached to the pulley, so that the spring tends to draw the pin *c* to one end of the slot. The arm *b'* is slotted and the slot fitted with a slide-piece, *f*, from which a pin, *g*, projects through a slot, *h*, formed in the web of the pulley eccentric to the axis thereof.

To the slide *f* two curved strips, *i i*, are fixed, which form eccentric flanges on the side of the slide. The slide also carries a bent arm, *k*, to the outer end of which is fixed a cam-piece, *l*.

On the post *m*, that carries a graduated dial-plate, *n*, a pointer, *o*, is hung, and from the inner end of the pointer a pin or stud, *p*, projects between the eccentric flanges *i* of slide *f*. The pointer is for indicating on the dial-plate *n* the amount of power being used, as hereinafter set forth. To obtain a permanent record the following devices are employed.

C represents the dial-plate of a time-piece, and *q* the hour-hand.

D is a dial on the arbor of the hand *q*, and held thereto by friction devices of suitable character, so that the dial shall turn with the arbor.

r is a rock-shaft, sustained in suitable bearings and carrying two arms, *s t*. The arm *s* is fixed on the shaft and is sustained in an upright position, or nearly so, by a stop-piece, *s'*, against which the arm is drawn by a spring, *u*. The arm *t* is loose on the shaft and is retained in an upright position, or nearly so, by a stop-pin, *t'*, which projects from the shaft *r*, against which the arm is drawn by a spring, *v*, that extends from pin *t'* to a hook, t^2, projecting from the lower end of arm *t*. The arm *t* is curved at its upper end to bear on the edge of dial D, and in its normal position is nearly in contact with the dial. The arm *s* has a pin or lug, *w*, at its upper end projecting into the plane of the cam-piece *l*, before mentioned as being carried by the slide *f*.

The dial D is marked on its face to indicate units of power, and when set for operation the hand *q* of the time-movement will be at the zero-mark of the dial.

In operation the shaft is to be driven by power and pulley B used for connection of the machinery to be driven. The arm *b* on the shaft, acting through pin *c* and spring *e*, carries the pulley with the shaft, and the tension of the spring is sufficient to retain the pin at the end of the slot *d* so long as no power is being used. In that position of the arm *b* the slide *f* is at the inward end of the slot of arm *b'*, the cam-flanges *i* pass by the pin *p* of the pointer without contact therewith, and the cam *l* is in its inward position. If power be taken from the pulley, the resistance thereby offered will check the pulley and cause the pin *c* to move out in the slot *d* until the tension of the spring *e* is sufficient to overcome the resistance, when the pulley will revolve and the pin remain stationary in the slot. The arm *b'* at the same time carries the pin *g* of slide *f* forward in the slot *h*, and the slide is forced outward, carrying with it the cam-flanges *i* and cam *l*. The inner flange

i, as it passes the pin *p* of the pointer, will now move the same to a distance corresponding with the radial movement of the slide, and the pointer will indicate the movement on the dial-plate. The cam *l* being by the movement of the slide thrown into position for striking the lug on arm *s*, the arm is thus moved outward, the pin *t'* is drawn away from arm *t*, and the spring *v* draws the arm *t* into contact with the dial D. This movement of arm *s* occurs at every revolution of the shaft, so that the arm *t* is pressed against the dial D in a series of pulsations with more or less pressure, according to the extent of radial movement of slide *f*. The effect is to retard the dial D, so that the hand gains on the dial a greater or less distance, according to the amount of power being used and the length of time during which the power is used. The dial, being properly marked to indicate its retardation, will make a record from day to day, and thus show the total number of units of power used. As soon as power is ceased to be taken from the pulley the spring *e* returns the parts to their normal position, and the outer cam-flange *i* will move the pointer *o* back to the zero-point. The dial D and hand *q* will then move together, as before, with the hand in the advanced position.

If desired, the dial D may be revolved by connections from the driving-shaft, instead of by the time-piece.

Having thus fully described my invention, I claim as new and desire to secure by Letters Patent—

1. In power indicating and recording mechanism, the combination of shaft A, carrying arms *b b'*, pulley B, provided with eccentric slot *h*, spring *e*, connecting the arm *b* and pulley, and the slide *f*, engaging slot *h* of the pulley, substantially as shown and described.

2. In power indicating and recording mechanism, the combination of radially-moving slide *f*, cam-flanges *i*, and pointer *o*, placed for engagement with the cam-flanges of the slide, substantially as shown and described.

3. In power indicating and recording mechanism, the combination of radially-moving slide *f*, cam *l*, rock-shaft *r*, and arm *t*, substantially as shown and described.

4. The combination, in power-recording mechanism, of revolving dial D, arm *t*, arm *s*, shaft *r*, provided with stop-pin *t'*, cam *l*, and slide *f*, carrying the cam, substantially as shown and described, for operation as set forth.

5. The combination, in power-recording mechanism, of a graduated dial, revolved by friction-connections, a retarding-arm hung adjacent to the dial, and a cam operated by the driving-shaft to press the retarding-arm in contact with the dial with a varying pressure, substantially as shown and described.

6. The combination, in power-recording mechanism, of a recording-dial, a time-piece moving in unison with the dial, and a dynamometer acting to retard the dial, substantially as shown and described.

GEORGE WALE.

Witnesses:

C. SEDGWICK,

J. H. SCARBOROUGH.

(No Model.) 2 Sheets—Sheet 1.

H. H. WESTINGHOUSE & W. A. BOLE.

SHAFT COUPLING.

No. 492,898. Patented Mar. 7, 1893.

Fig. 2.

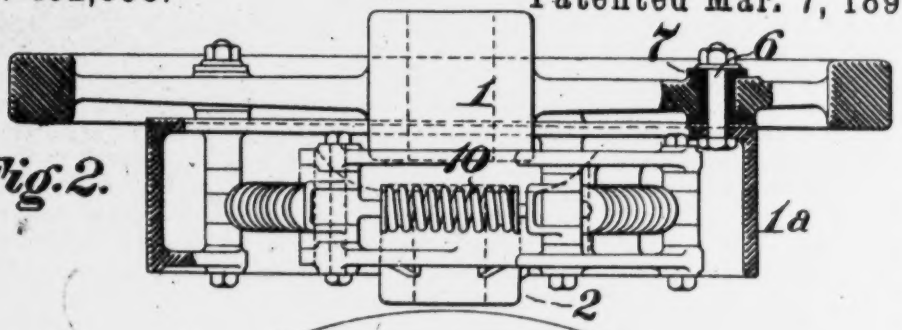


Fig. 1.

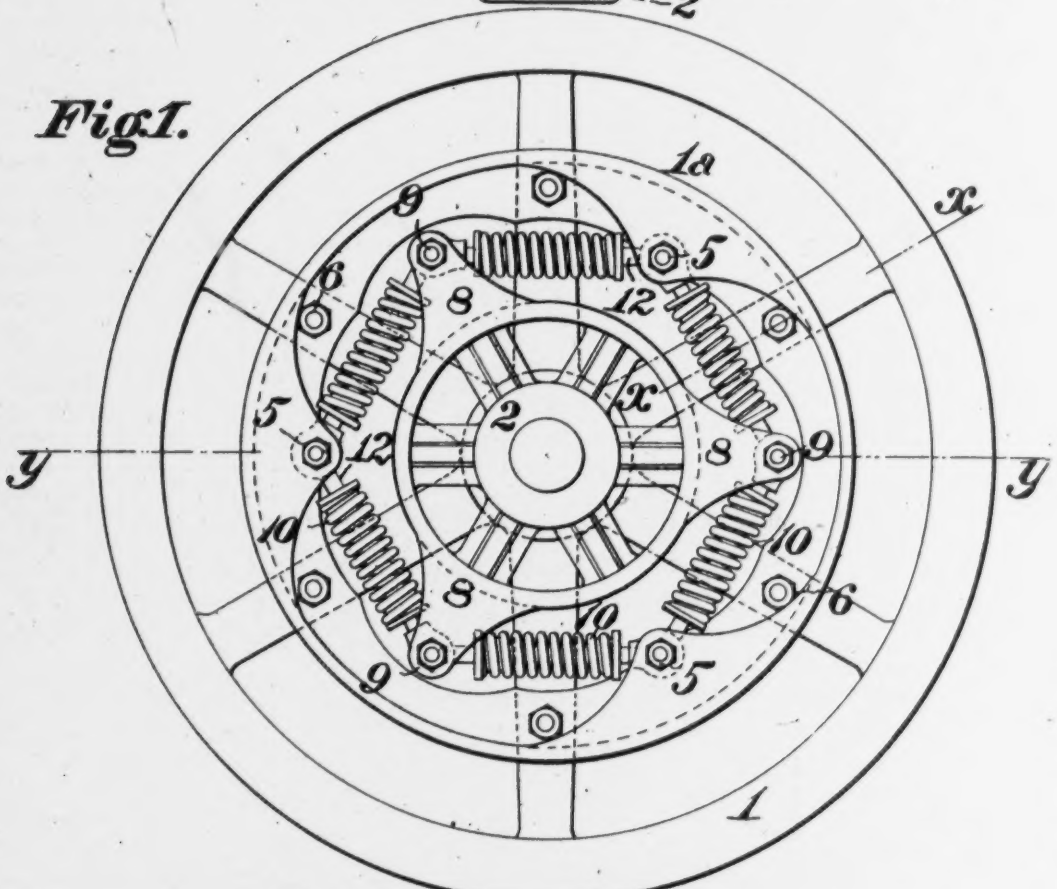
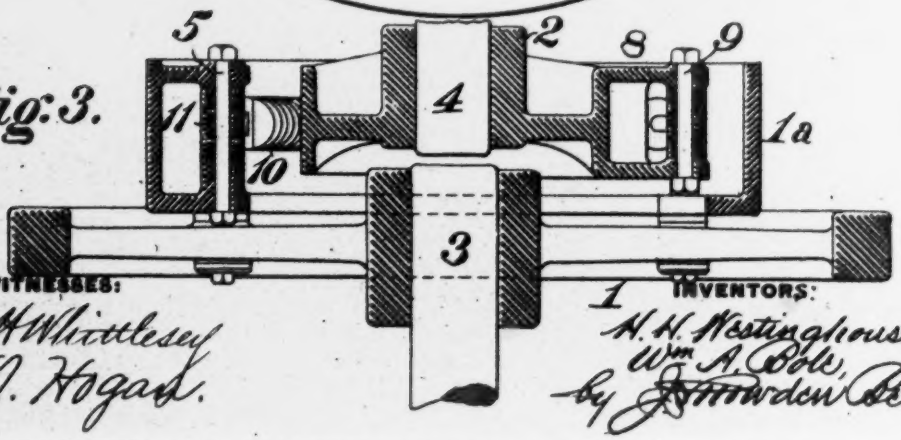


Fig. 3.



WITNESSES:

R. H. Whittlesey

F. J. Hogan.

INVENTORS:

H. H. Westinghouse

Wm. A. Bole,

by Edwin Bell

Att'y.

132

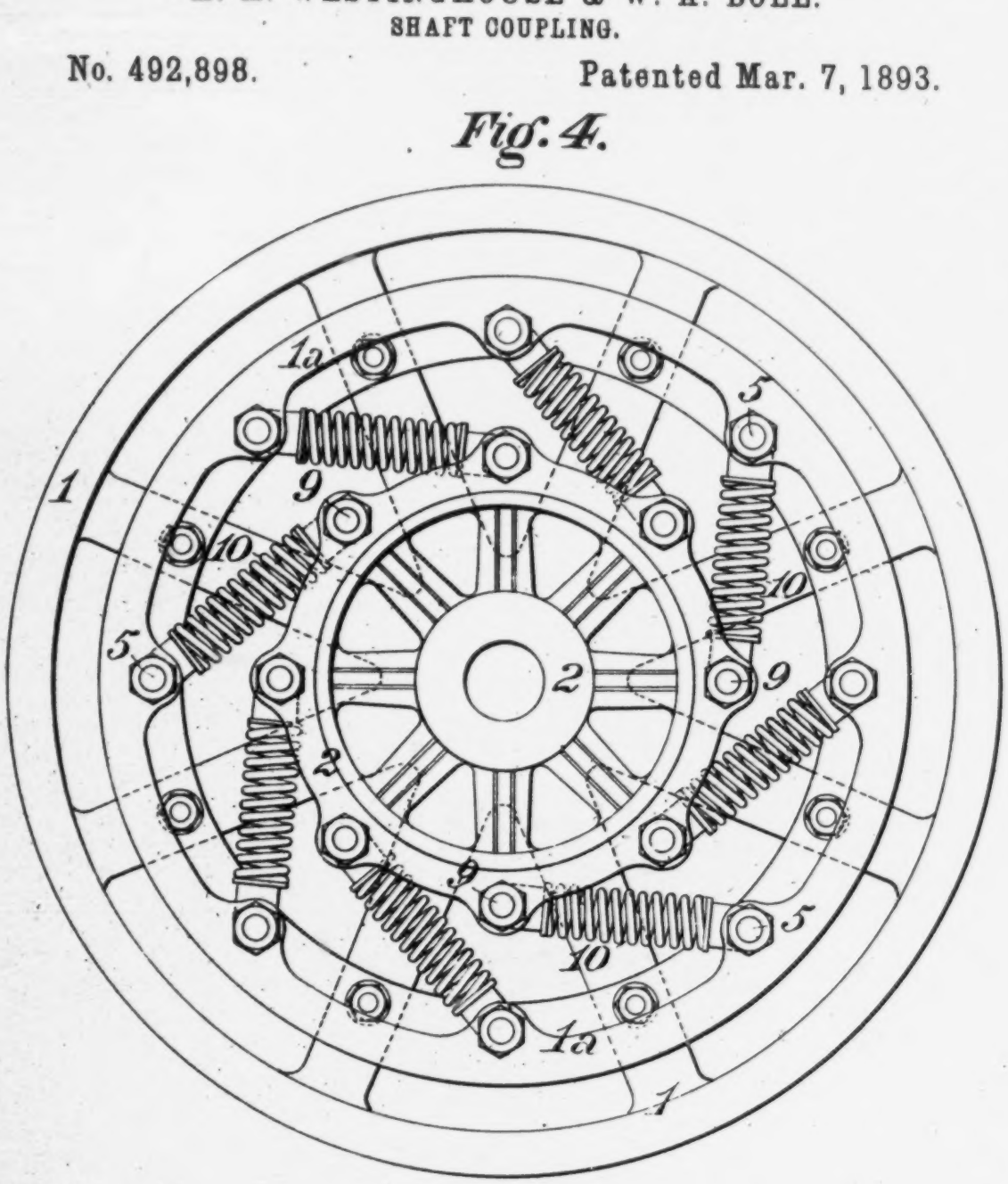
(No Model.) 2 Sheets—Sheet 2.

H. H. WESTINGHOUSE & W. A. BOLE.

SHAFT COUPLING.

No. 492,898. Patented Mar. 7, 1893.

Fig. 4.



WITNESSES:

R. N. Whiteley

F. A. Howson

INVENTORS.

H. H. Westinghouse,

Wm. A. Bole

by Dowson & Ball

UNITED STATES PATENT OFFICE.

HENRY HERMAN WESTINGHOUSE AND WILLIAM A. BOLE, OF PITTSBURG, PENNSYLVANIA.

SHAFT-COUPLING.

SPECIFICATION forming part of Letters Patent No. 492,898, dated March 7, 1893.

Application filed June 30, 1892. Serial No. 438,827. (No model.)

To all whom it may concern:

Be it known that we, HENRY HERMAN WESTINGHOUSE and WILLIAM A. BOLE, citizens of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered a certain new and useful Improvement in Shaft-Couplings, of which improvement the following is a specification.

Our improvement relates to shaft couplings of the flexible class or type, in which provision is made for variation from axial alignment of the connected sections, and an elastic application of driving power is effected.

The object of our invention is to provide a shaft coupling of such type having a greater capacity of flexibility than heretofore, and in which the transmission of driving power will be divided uniformly between the several elastic connecting members through which it is imparted.

To this end, our invention, generally stated, consists in the combination of two coupling heads or frames, each adapted to be fixed upon an independent shaft section, and a series of tangentially disposed springs, each coupled at one end to one of the coupling heads, and at the opposite end to the other coupling head; also in the combination with a shaft coupling as specified, of an insulating medium, interposed between the main portion of one of the coupling heads and the members connecting the same with the other coupling head. The improvement claimed is hereinafter fully set forth.

In the accompanying drawings: Figure 1 is an end view, in elevation, of a shaft coupling illustrating an application of our invention; Fig. 2, a view, partly in side elevation and partly in transverse section at the line x, x, of Fig. 1; Fig. 3, a transverse section at the line y, y, of Fig. 1, and; Fig. 4, an end view, in elevation, illustrating a modification in the disposition of the springs.

In the practice of our invention, referring to Figs. 1, 2, and 3, we provide two coupling heads or frames, 1, 2, which are provided with central hubs, adapted, respectively, to be secured upon the ends of the shaft sections 3 and 4. To the spokes of the spoked wheel 1 there is secured, concentrically, an annular flanged supplemental section 1^a, provided with a series of suitable coupling connections, as in the instances shown, pins or bolts 5, fitted, with their axes substantially parallel to the axis of the head 1. The supplemental section 1^a is secured to the head 1, by bolts 6, direct contact of the connected members with each other, and with the connecting bolt 6, being prevented by thimbles 7, of any suitable insulating material, surrounding the bolts and provided with end flanges which prevent contact of metal with metal, at the ends of the bolts.

The head 2, which is secured upon the shaft section 4, is in the form of a wheel or disk, which is, similarly to the supplemental section 1^a of the head 1, provided with a series of coupling connections, said head 2 having, in the form herein shown, peripheral lugs or bearings 8, in which are fitted a series of coupling pins or bolts 9, corresponding in number with the pins 5 which are fitted in the supplemental section 1^a of the head 1, and having, like the latter, their axes substantially parallel with the axis of the head on which they are carried. The outer diameter of the head 2, both over its lugs 8, and on its body, is sufficiently less than the inner diameter of the body of the supplemental section 1^a of the head 1, and the diametrical distance between its lugs 5, to allow free lateral movement of the heads 1 and 2, and the shaft sections to which they are secured, relatively one to the other.

The heads 1 and 2 are so arranged that the coupling pins 5 of the former shall alternate in position with the pins 9 of the latter, and the alternate pins are connected one to another by a series of helical springs 10, which are disposed tangentially, that is to say, the axial line of each spring is substantially tangential to a circle described about the center of the coupling head to which one end of the spring is coupled, and passing through the point of connection of the spring to said head. The springs 10 are so coiled as to have

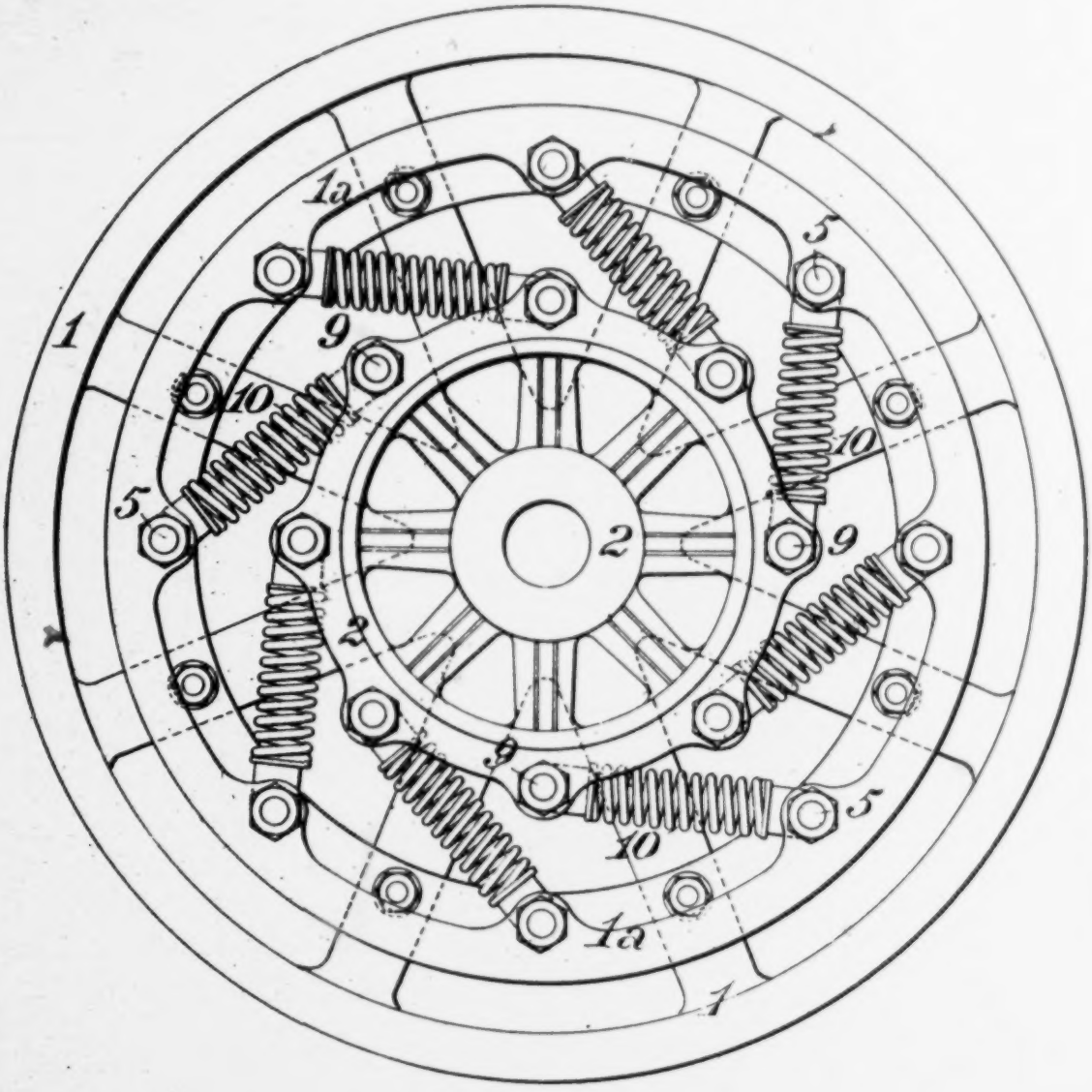
(No Model.) 2 Sheets—Sheet 2.

H. H. WESTINGHOUSE & W. A. BOLE.

SHAFT COUPLING.

No. 492,898. Patented Mar. 7, 1893.

Fig. 4.



WITNESSES:

R. N. Whiteley

F. J. Hogan.

INVENTORS.

H. H. Westinghouse,

Wm. A. Bole

by Howson & Sell, Att'y

UNITED STATES PATENT OFFICE.

HENRY HERMAN WESTINGHOUSE AND WILLIAM A. BOLE, OF PITTSBURG, PENNSYLVANIA.

SHAFT-COUPLING.

SPECIFICATION forming part of Letters Patent No. 492,898, dated March 7, 1893.

Application filed June 30, 1892. Serial No. 438,627. (No model.)

To all whom it may concern:

Be it known that we, HENRY HERMAN WESTINGHOUSE and WILLIAM A. BOLE, citizens of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered a certain new and useful Improvement in Shaft-Couplings, of which improvement the following is a specification.

Our improvement relates to shaft couplings of the flexible class or type, in which provision is made for variation from axial alignment of the connected sections, and an elastic application of driving power is effected.

The object of our invention is to provide a shaft coupling of such type having a greater capacity of flexibility than heretofore, and in which the transmission of driving power will be divided uniformly between the several elastic connecting members through which it is imparted.

To this end, our invention, generally stated, consists in the combination of two coupling heads or frames, each adapted to be fixed upon an independent shaft section, and a series of tangentially disposed springs, each coupled at one end to one of the coupling heads, and at the opposite end to the other coupling head; also in the combination with a shaft coupling as specified, of an insulating medium, interposed between the main portion of one of the coupling heads and the members connecting the same with the other coupling head. The improvement claimed is hereinafter fully set forth.

In the accompanying drawings: Figure 1 is an end view, in elevation, of a shaft coupling illustrating an application of our invention; Fig. 2, a view, partly in side elevation and partly in transverse section at the line x, x, of Fig. 1; Fig. 3, a transverse section at the line y, y, of Fig. 1, and; Fig. 4, an end view, in elevation, illustrating a modification in the disposition of the springs.

In the practice of our invention, referring to Figs. 1, 2, and 3, we provide two coupling heads or frames, 1, 2, which are provided with central hubs, adapted, respectively, to be secured upon the sections 3, 4, of shafting to be coupled together. The main body of the head 1 is preferably, as shown, in the form of a spoked wheel to the spokes of which there is secured, concentrically, an annular flanged supplemental section 1^a, provided with a series of suitable coupling connections, as in the instances shown, pins or bolts 5, fitted, with their axes substantially parallel to the axis of the head 1. The supplemental section 1^a is secured to the head 1, by bolts 6, direct contact of the connected members with each other, and with the connecting bolt 6, being prevented by thimbles 7, of any suitable insulating material, surrounding the bolts and provided with end flanges which prevent contact of metal with metal, at the ends of the bolts.

The head 2, which is secured upon the shaft section 4, is in the form of a wheel or disk, which is, similarly to the supplemental section 1^a of the head 1, provided with a series of coupling connections, said head 2 having, in the form herein shown, peripheral lugs or bearings 8, in which are fitted a series of coupling pins or bolts 9, corresponding in number with the pins 5 which are fitted in the supplemental section 1^a of the head 1, and having, like the latter, their axes substantially parallel with the axis of the head on which they are carried. The outer diameter of the head 2, both over its lugs 8, and on its body, is sufficiently less than the inner diameter of the body of the supplemental section 1^a of the head 1, and the diametrical distance between its lugs 5, to allow free lateral movement of the heads 1 and 2, and the shaft sections to which they are secured, relatively one to the other.

The heads 1 and 2 are so arranged that the coupling pins 5 of the former shall alternate in position with the pins 9 of the latter, and the alternate pins are connected one to another by a series of helical springs 10, which are disposed tangentially, that is to say, the axial line of each spring is substantially tangential to a circle described about the center of the coupling head to which one end of the spring is coupled, and passing through the point of connection of the spring to said head. The springs 10 are so coiled as to be capable of either extension or compression, and one end of each spring is coupled to one of the bolts 5, and the opposite end to one of the

bolts 9. Each coupling pin of each head is therefore, as shown in Fig. 1, connected, by oppositely extending springs, with the two adjacent coupling pins of the other head. In the rotation of the coupled shaft sections in either direction, either being the driving member, the driving power is imparted to the other shaft section through the series of springs 10, and as two of these are coupled to each of the pins 5 of the supplemental section 1^a of the head 1, and two to each of the pins 9 of the head 2, it will be seen that one half of the series of springs will be under uniform tension and act to elastically transmit the driving power to the driven section, while the other half of the series will be subject uniformly to compression, and will so transmit the driving power, as well as, by their elasticity, serve to cushion and reduce jars due to any inequalities or sudden variations in power or resistance.

By reason of the tangential disposition of the several springs of the series, as hereinbefore specified, a greater range of variation of alignment of the coupled shaft sections is admissible, without distortion or other injury to the springs, than where, as in prior instances in the art, the shaft sections are connected by springs whose common axial line is coincident with the normal axial line of the shaft sections. It will further be seen that as each of the series of coupling springs 10, is not opposed or restricted as to movement by any bearing surface between its end connections, and there being free space provided between each end connection and the opposite coupling head as before described, lateral movement of the shaft sections, under variations of alignment, is fully provided for and permitted. The springs 10 are positively connected at their ends, to the pins 5 and 9, by blocks 11, fitting truly thereon, so as to provide ample bearing surface. The blocks 11 are provided with end stems 12 connected to the springs in any suitable and convenient manner so as to be substantially integral with the springs, as by blocks grooved externally to fit within the coils of the springs. As shown in Figs. 2 and 3, one of the blocks 11 on each coupling pin, is divided, so as to provide two bearings, fitting the pin on opposite sides of the bearing of the other block thereon.

The modification illustrated in Fig. 4, differs from that before described in the particular that all of the series of springs are subject either to tension or to compression (according to the direction of rotation of the coupled shaft sections, or to the section which is employed as the driving member) in lieu of one-half the series of springs being subject, in operation, to tension, and the other half to compression, as in the previous instance in position, nor is each pin of one head coupled by oppositely extending springs to two pins of the other head. It therefore results that all the springs will transmit the driving power from one to the other shaft section either under tension or under compression, accordingly as may be determined by the direction of rotation or the selection of the driving member.

While we have specified pins or bolts as the preferred means for connecting the springs to the coupling heads, deeming these to be most convenient and desirable for this purpose, we do not desire to limit ourselves to such specific form of attachment, as any other suitable means for connecting the springs alternately to one and the other head, would similarly perform the same function and, in the operation of the coupling, act as a mechanical equivalent for that shown.

It will be seen that under our invention as above described, a material range of flexibility is afforded in the coupling, so as to admit of variations of alignment of either or both of the coupled sections, without interfering with their rotation or imparting injurious strain to the connecting members. Thus, the shafts may rotate, with a substantially uniform division of the transmission of driving power among the several springs, either when in the normal condition of being in common axial line, or when either or both shafts should be at an angle to the normal axial line, or when both shafts should be in such position that their axial lines would fail to meet.

We claim as our invention and desire to secure by Letters Patent—

1. The combination, in a shaft coupling, of two coupling heads, fixed upon independent shaft sections and wholly disengaged one from the other so as to have a free range of relative lateral movement, and a series of tangentially disposed springs, each coupled at one end to one head and at its opposite end to the other, and being located in an annular space between the coupling heads which is of greater transverse dimensions than the diameter of the springs, so as to have the capacity of lateral movement with either or both coupling heads, substantially as set forth.

2. The combination, in a shaft coupling, of two coupling heads, fixed upon independent shaft sections and wholly disengaged one from the other, so as to have a free range of lateral movement, a series of coupling pins fixed in each head and a series of tangentially disposed springs, each coupled at one end to a coupling pin of one head and at its opposite end to a coupling pin of the other, and being located in an annular space between the coupling heads which is of greater transverse dimensions than the diameter of the springs, so as to have the capacity of lateral movement

connecting said heads, one to the other, each point of spring attachment upon either head being coupled, in opposite directions, respectively, to two points on the other, substantially as set forth.

4. The combination, in a shaft coupling, of two coupling heads, each adapted to be fixed upon a shaft section, a series of coupling pins fitted in each head, the pins of one head being alternated in position, relatively to those of the other, and a series of springs connecting a coupling pin of one head with the two adjacent coupling pins of the other head, substantially as set forth.

5. The combination, in a shaft coupling, of two coupling heads, each adapted to be secured upon a shaft section, one of said heads being divided into two sections, an insulating medium interposed between said sections at their point of connection, a series of coupling pins fitted in one of said sections, a series of coupling pins fitted in the other head, and a series of springs, each coupled at one end to a coupling pin of one head and at its opposite end to a coupling pin of the other, substantially as set forth.

In testimony whereof we have hereunto set our hands.

HENRY HERMAN WESTINGHOUSE.
WM. A. BOLE.

Witnesses:
J. SNOWDEN BELL,
R. H. WHITTLESEY.

bolts 9. Each coupling pin of each head is therefore, as shown in Fig. 1, connected, by oppositely extending springs, with the two adjacent coupling pins of the other head. In the rotation of the coupled shaft sections in either direction, either being the driving member, the driving power is imparted to the other shaft section through the series of springs 10, and as two of these are coupled to each of the pins 5 of the supplemental section 1^a of the head 1, and two to each of the pins 9 of the head 2, it will be seen that one half of the series of springs will be under uniform tension and act to elastically transmit the driving power to the driven section, while the other half of the series will be subject uniformly to compression, and will so transmit the driving power, as well as, by their elasticity, serve to cushion and reduce jars due to any inequalities or sudden variations in power or resistance.

By reason of the tangential disposition of the several springs of the series, as hereinbefore specified, a greater range of variation of alignment of the coupled shaft sections is admissible, without distortion or other injury to the springs, than where, as in prior instances in the art, the shaft sections are connected by springs whose common axial line is coincident with the normal axial line of the shaft sections. It will further be seen that as each of the series of coupling springs 10, is not opposed or restricted as to movement by any bearing surface between its end connections, and there being free space provided between each end connection and the opposite coupling head as before described, lateral movement of the shaft sections, under variations of alignment, is fully provided for and permitted. The springs 10 are positively connected at their ends, to the pins 5 and 9, by blocks 11, fitting truly thereon, so as to provide ample bearing surface. The blocks 11 are provided with end stems 12 connected to the springs in any suitable and convenient manner so as to be substantially integral with the springs, as by blocks grooved externally to fit within the coils of the springs. As shown in Figs. 2 and 3, one of the blocks 11 on each coupling pin, is divided, so as to provide two bearings, fitting the pin on opposite sides of the bearing of the other block thereon.

The modification illustrated in Fig. 4, differs from that before described in the particular that all of the series of springs are subject either to tension or to compression (according to the direction of rotation of the coupled shaft sections, or to the section which is employed as the driving member) in lieu of one half the series of springs being subject, in operation, to tension, and the other half to compression, as in the previous instance. Each of the springs 10, is, in Fig. 4, as in the previous instance, coupled at one end to a pin 5 of the section 1^a, and, at the other, to a pin 9 of the head 2, but the pins of the respective heads are not, as before, necessarily alternated in position, nor is each pin of one head coupled by oppositely extending springs to two pins of the other head. It therefore results that all the springs will transmit the driving power from one to the other shaft section either under tension or under compression, accordingly as may be determined by the direction of rotation or the selection of the driving member.

While we have specified pins or bolts as the preferred means for connecting the springs to the coupling heads, deeming these to be most convenient and desirable for the purpose, we do not desire to limit ourselves to such specific form of attachment, as any other suitable means for connecting the springs alternately to one and the other head, would similarly perform the same function and, in the operation of the coupling, act as a mechanical equivalent for that shown.

It will be seen that under our invention as above described, a material range of flexibility is afforded in the coupling, so as to admit of variations of alignment of either or both of the coupled sections, without interfering with their rotation or imparting injurious strain to the connecting members. Thus, the shafts may rotate, with a substantially uniform division of the transmission of driving power among the several springs, either when in the normal condition of being in common axial line, or when either or both shafts should be at an angle to the normal axial line, or when both shafts should be in such position that their axial lines would fail to meet.

We claim as our invention and desire to secure by Letters Patent—

1. The combination, in a shaft coupling, of two coupling heads, fixed upon independent shaft sections and wholly disengaged one from the other so as to have a free range of relative lateral movement, and a series of tangentially disposed springs, each coupled at one end to one head and at its opposite end to the other, and being located in an annular space between the coupling heads which is of greater transverse dimensions than the diameter of the springs, so as to have the capacity of lateral movement with either or both coupling heads, substantially as set forth.

2. The combination, in a shaft coupling, of two coupling heads, fixed upon independent shaft sections and wholly disengaged one from the other, so as to have a free range of lateral movement, a series of coupling pins fitted in each head, and a series of tangentially disposed springs, each coupled at one end to a coupling pin of one head and at its opposite end to a coupling pin of the other, and being located in an annular space between the coupling heads which is of greater transverse dimensions than the diameter of the springs, so as to have the capacity of lateral movement with either or both coupling heads, substantially as set forth.

3. The combination, in a shaft coupling, of two coupling heads, each adapted to be fixed upon a shaft section, and a series of springs

connecting said heads, one to the other, each point of spring attachment upon either head being coupled, in opposite directions, respectively, to two points on the other, substantially as set forth.

4. The combination, in a shaft coupling, of two coupling heads, each adapted to be fixed upon a shaft section, a series of coupling pins fitted in each head, the pins of one head being alternated in position, relatively to those of the other, and a series of springs connecting a coupling pin of one head with the two adjacent coupling pins of the other head, substantially as set forth.

5. The combination, in a shaft coupling, of two coupling heads, each adapted to be secured upon a shaft section, one of said heads being divided into two sections, an insulating medium interposed between said sections at their point of connection, a series of coupling pins fitted in one of said sections, a series of coupling pins fitted in the other head, and a series of springs, each coupled at one end to a coupling pin of one head and at its opposite end to a coupling pin of the other, substantially as set forth.

In testimony whereof we have hereunto set our hands.

HENRY HERMAN WESTINGHOUSE.
WM. A. BOLE.

Witnesses:
J. SNOWDEN BELL,
R. H. WHITTLESEY.

T. R. MOORE.

TRANSMISSION DYNAMOMETER.

APPLICATION FILED APR. 4, 1908.

930,605.

Patented Aug. 10, 1909.

2 SHEETS—SHEET 1.

Fig. 1.

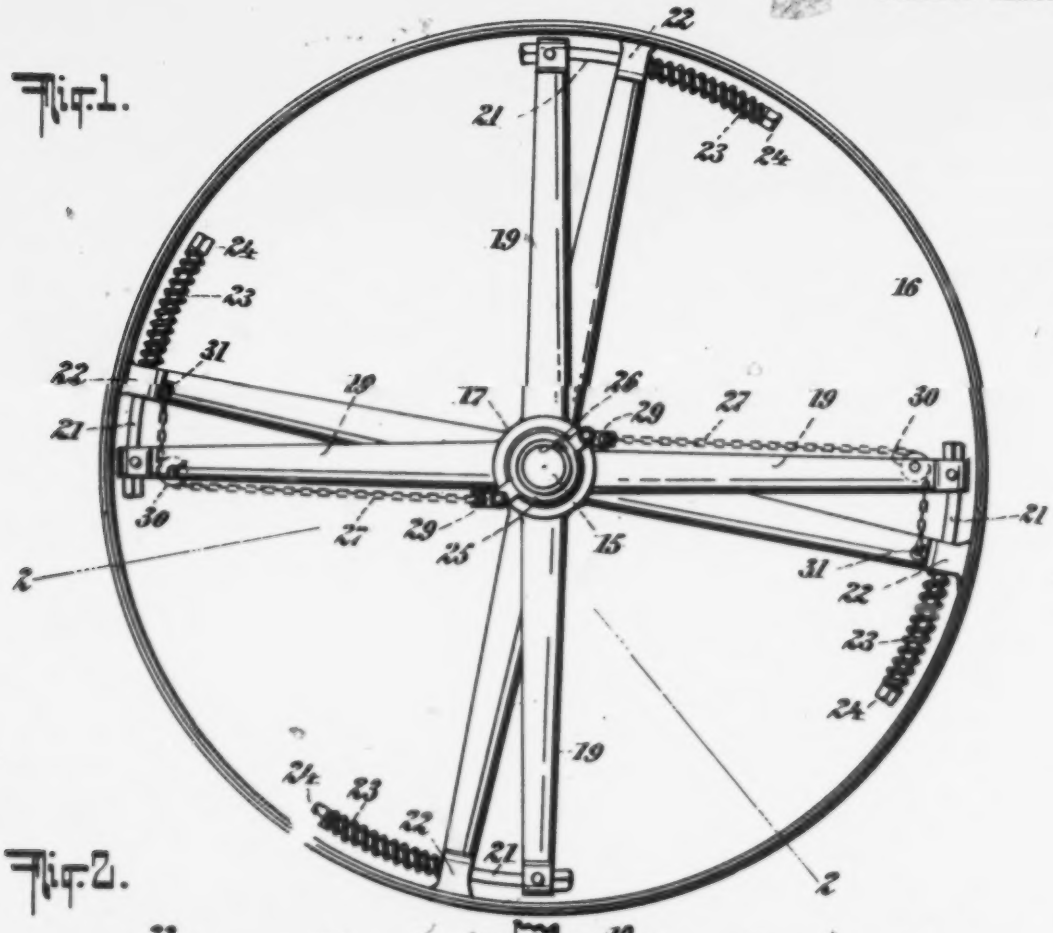


Fig. 2.

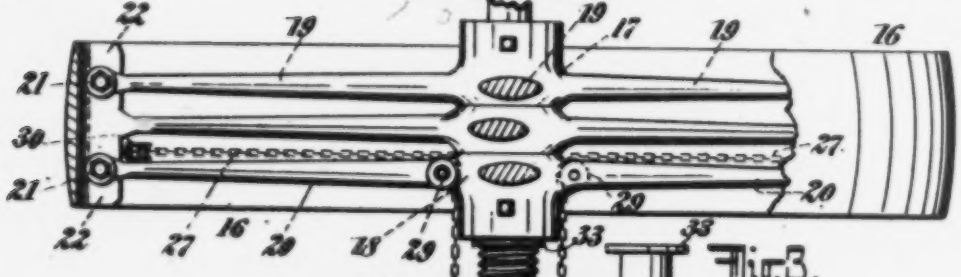


Fig. 3.

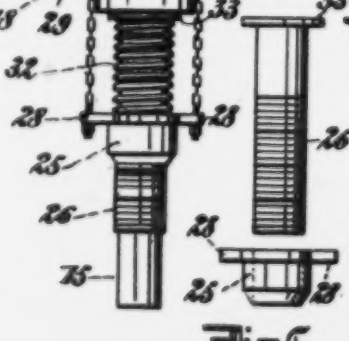


Fig. 4.

Fig. 5.

WITNESSES:

Edwin L. Whitwell

George Bamberg.

INVENTOR

Thomas R. Moore

BY

Chas. C. Gill

ATTORNEY

140

T. R. MOORE.

TRANSMISSION DYNAMOMETER.

APPLICATION FILED APR. 4, 1908.

930,605.

Patented Aug. 10, 1909.

2 SHEETS—SHEET 2.

Fig. 6.

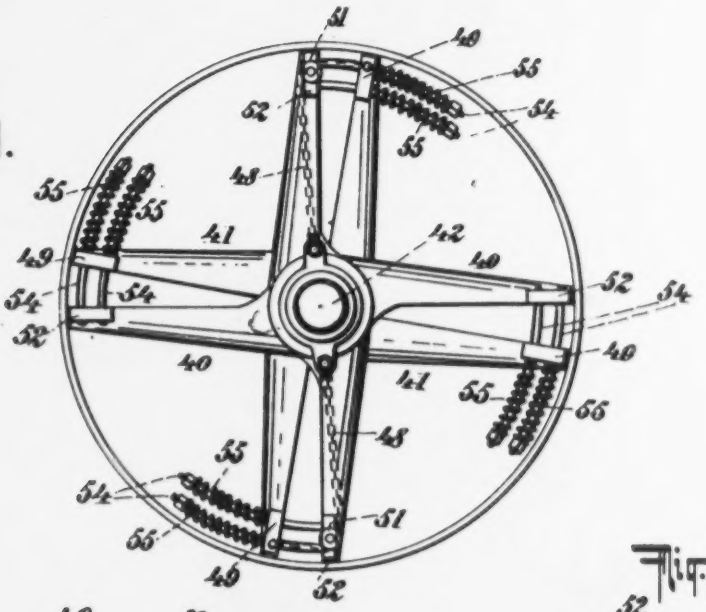


Fig. 8.

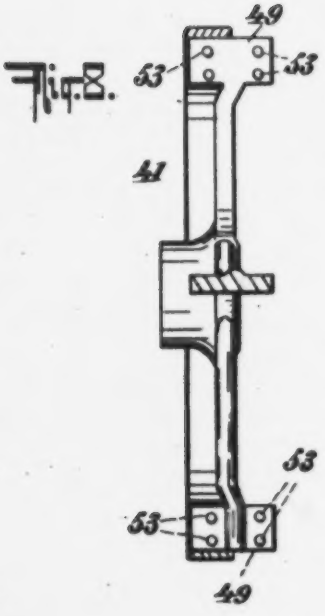


Fig. 9.

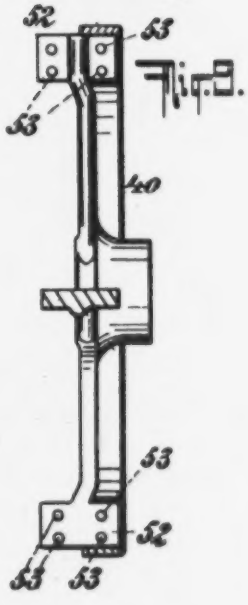
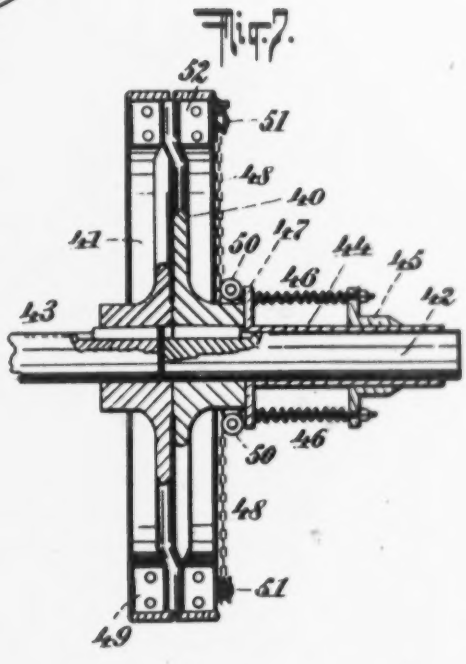


Fig. 7.



WITNESSES:

Edwin Whitfield.

INVENTOR

Thomas R. Moore

BY

UNITED STATES PATENT OFFICE.

THOMAS R. MOORE, OF WALDEN, NEW YORK.

TRANSMISSION-DYNAMOMETER.

No. 930,605. Specification of Letters Patent. Patented Aug. 10, 1909.

Application filed April 4, 1908. Serial No. 425,099.

To all whom it may concern:

Be it known that I, THOMAS R. MOORE, a citizen of the United States, and a resident of Walden, in the county of Orange and State of New York, have invented certain new and useful Improvements in Transmission-Dynamometers, of which the following is a specification.

The invention relates to improvements in dynamometer pulleys, couplings, gears, and the like; and it consists in the novel features, structure and combinations of parts hereinafter described, and particularly pointed out in the claims.

The object of the invention is to afford a simple, inexpensive, efficient and conveniently read dynamometer which when in use will at all times indicate the power consumed.

The invention will be fully understood from the detailed description hereinafter presented, reference being had to the accompanying drawings, in which:

Figure 1 is a side elevation of a pulley wheel embodying the dynamometer construction of my invention; Fig. 2 is a bottom view (with the pulley turned over to bring its lower side up) partly broken away and partly in section, of the same, the break in the rim of the wheel being at about the dotted lines 2—2 of Fig. 1 and the dynamometer graduated sleeve and slide therefor being omitted from that end of the shaft which appears at the upper portion of Fig. 2; Fig. 3 is a detached side elevation of a sleeve to be applied upon the shaft and having graduations thereon denoting pounds or horse-power and fractions thereof; Fig. 4 is a like view of the slide adapted when in use to move along the graduated sleeve for indicating the pounds or horse-power consumed; Fig. 5 is an end view of the same; Fig. 6 is a side elevation of a coupling embodying my invention; Fig. 7 is a vertical transverse section of the same, and Figs. 8 and 9 are detached vertical sectional views showing the coupling members separated from each other and ready to be assembled in the manner shown in Fig. 7.

In the drawings, referring to Figs. 1 to 5 inclusive, 15 designates a usual shaft, and 16 a pulley wheel comprising a hub, spokes and and each comprising a hub and radial arms 19, 20, respectively, which extend outwardly to within a suitable distance from the inner surface of the rim of the wheel 16 and are apertured at their outer ends to receive curved rods 21 carried by them, these rods being curved on the arc of a circle whose center is the center of the shaft 15. The wheel 16 is, preferably at the outer ends of its spokes, formed integrally with transverse flanges 22, which are apertured to permit the rods 21 to freely pass through them. The rods 21 are carried by the arms of the frames 17, 18 and thence extend through the apertures of the flanges 22 and beyond said flanges are provided with coiled springs 23 which are retained upon the rods by heads or nuts 24 or other suitable means. The springs 23 are always under tension and normally draw the outer ends of the arms 19, 20 of the frames 17, 18 against the flanges 22 of the wheel 16. When the dynamometer is in use, the arms 19, 20 of the frames 17, 18 will be drawn away and stand off from the flanges 22 in the manner shown in Fig. 1, with the springs 23 under compression and normally acting to restore the ends of said arms to position against said flanges. The movement of the arms 19, 20 toward and from the flanges 22 is utilized to operate slides 25 mounted upon sleeves 26 which are on the shaft 15, one of said sleeves and one of said slides being at each side of the pulley wheel and each slide being connected with the wheel 16, preferably at the flanges 22 thereof, by means of chains or other suitable flexible connections 27. The slides 25 closely fit upon the sleeves 26, without binding thereon, and have beveled outer edges and laterally extending arms 28 at their inner edges to which the chains 27 are connected and whence said chains pass inwardly and over small pulley-wheels 29 carried by the frames 17, 18 and thence outwardly to the outer portions of said frames and around pulley-wheels 30 carried thereby, the outer ends of the chains 27 after passing over the pulleys 30 being secured, as at 31, to the flanges 22 of the main pulley-wheel. The arms 28 on the slide 25 are oppositely disposed so that the chains 27 may exert a uniform pull on said slide, and said chains 27 after passing over the pulley-wheels 29 extend outwardly

APPLICATION FILED APR. 4, 1908.

930,605.

Patented Aug. 10, 1909.

2 SHEETS—SHEET 2.

Fig. 6.

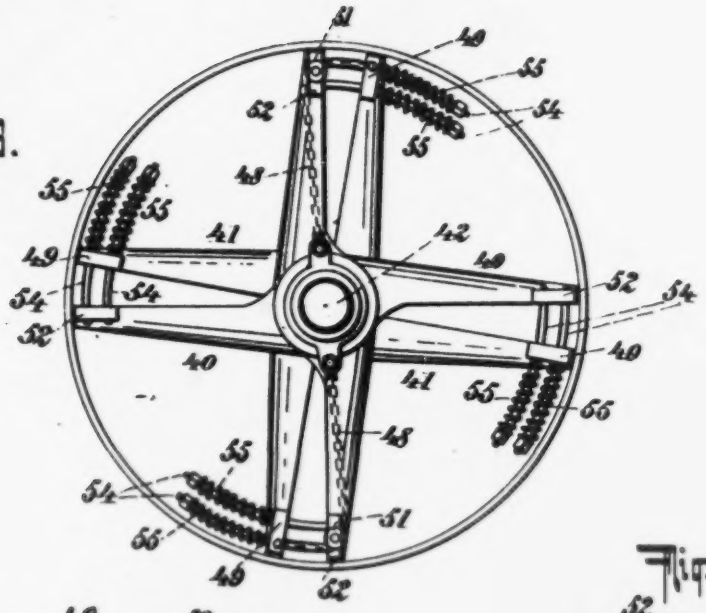


Fig. 8.

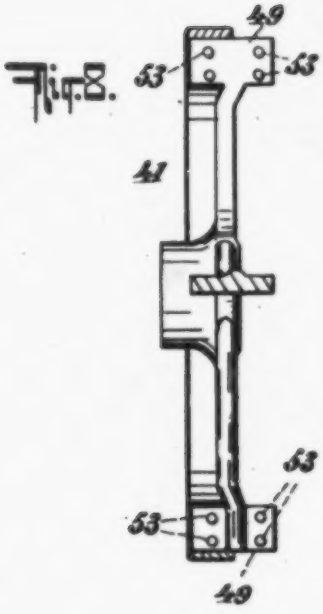


Fig. 9.

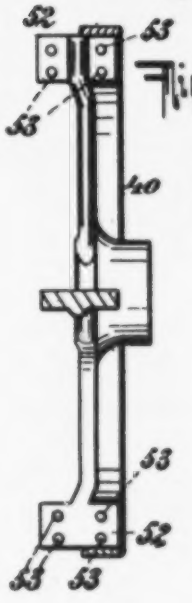
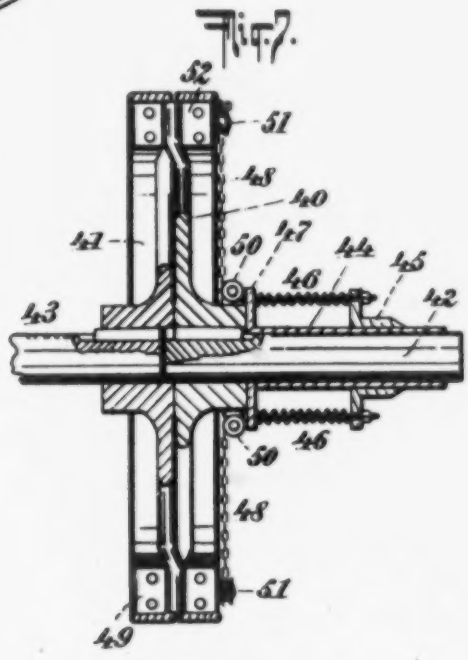


Fig. 7.



WITNESSES:

Edwin Whitfield.

George Bamby.

INVENTOR

Thomas R. Moore

BY

Chas. C. Gill

ATTORNEY

UNITED STATES PATENT OFFICE.

THOMAS R. MOORE, OF WALDEN, NEW YORK.

TRANSMISSION-DYNAMOMETER.

No. 930,606. Specification of Letters Patent. Patented Aug. 10, 1909.

Application filed April 4, 1908. Serial No. 425,669.

To all whom it may concern:

Be it known that I, THOMAS R. MOORE, a citizen of the United States, and a resident of Walden, in the county of Orange and State of New York, have invented certain new and useful Improvements in Transmission-Dynamometers, of which the following is a specification.

The invention relates to improvements in dynamometer pulleys, couplings, gears, and the like; and it consists in the novel features, structure and combinations of parts hereinafter described, and particularly pointed out in the claims.

The object of the invention is to afford a simple, inexpensive, efficient and conveniently read dynamometer which when in use will at all times indicate the power consumed.

The invention will be fully understood from the detailed description hereinafter presented, reference being had to the accompanying drawings, in which:

Figure 1 is a side elevation of a pulley wheel embodying the dynamometer construction of my invention; Fig. 2 is a bottom view (with the pulley turned over to bring its lower side up) partly broken away and partly in section, of the same, the break in the rim of the wheel being at about the dotted lines 2—2 of Fig. 1 and the dynamometer graduated sleeve and slide therefor being omitted from that end of the shaft which appears at the upper portion of Fig. 2; Fig. 3 is a detached side elevation of a sleeve to be applied upon the shaft and having graduations thereon denoting pounds or horse-power and fractions thereof; Fig. 4 is a like view of the slide adapted when in use to move along the graduated sleeve for indicating the pounds or horse-power consumed; Fig. 5 is an end view of the same; Fig. 6 is a side elevation of a coupling embodying my invention; Fig. 7 is a vertical transverse section of the same, and Figs. 8 and 9 are detached vertical sectional views showing the coupling members separated from each other and ready to be assembled in the manner shown in Fig. 7.

In the drawings, referring to Figs. 1 to 5 inclusive, 15 designates a usual shaft, and 16 a pulley wheel comprising a hub, spokes and rim mounted on said shaft. Upon the shaft 15, at opposite sides of the hub of the pulley-wheel 16, are secured spider frames 17, 18, respectively, corresponding with each other and each comprising a hub and radial arms 19, 20, respectively, which extend outwardly to within a suitable distance from the inner surface of the rim of the wheel 16 and are apertured at their outer ends to receive curved rods 21 carried by them, these rods being curved on the arc of a circle whose center is the center of the shaft 15. The wheel 16 is, preferably at the outer ends of its spokes, formed integrally with transverse flanges 22, which are apertured to permit the rods 21 to freely pass through them. The rods 21 are carried by the arms of the frames 17, 18 and thence extend through the apertures of the flanges 22 and beyond said flanges are provided with coiled springs 23 which are retained upon the rods by heads or nuts 24 or other suitable means. The springs 23 are always under tension and normally draw the outer ends of the arms 19, 20 of the frames 17, 18 against the flanges 22 of the wheel 16. When the dynamometer is in use, the arms 19, 20 of the frames 17, 18 will be drawn away and stand off from the flanges 22 in the manner shown in Fig. 1, with the springs 23 under compression and normally acting to restore the ends of said arms to position against said flanges. The movement of the arms 19, 20 toward and from the flanges 22 is utilized to operate slides 25 mounted upon sleeves 26 which are on the shaft 15, one of said sleeves and one of said slides being at each side of the pulley wheel and each slide being connected with the wheel 16, preferably at the flanges 22 thereof, by means of chains or other suitable flexible connections 27. The slides 25 closely fit upon the sleeves 26, without binding thereon, and have beveled outer edges and laterally extending arms 28 at their inner edges to which the chains 27 are connected and whence said chains pass inwardly and over small pulley-wheels 29 carried by the frames 17, 18 and thence outwardly to the outer portions of said frames and around pulley-wheels 30 carried thereby, the outer ends of the chains 27 after passing over the pulleys 30 being secured, as at 31, to the flanges 22 of the main pulley-wheel. The arms 28 on the slide 25 are oppositely disposed so that the chains 27 may exert a uniform pull on said slide, and said chains 27 after passing over the pulley-wheels 29 extend outwardly in opposite directions so that they may be acted upon by opposite radial arms of the frames 17, 18. The slides 25 are normally pressed outwardly by means of coiled springs

32 which are on the sleeves 26 intermediate the flanges 33 thereof and the inner ends of said slides. The action of the springs 32 will keep the slides 25 pressed outwardly and the chains 27 under light tension, and when the opposite radial arms of the frames 17, 18 are moved in a direction from the flanges 22, as shown in Fig. 1, said arms by moving against the chains 27 act to pull the outer ends of said chains toward the pulley-wheel 16, thereby causing the slides 25 to move inwardly along the sleeves 26 under the opposition of the springs 32. When the opposite radial arms of the frames 17, 18 move in a direction toward the flanges 22 they gradually release their pressure on the chains 27 and the springs 32, at such times, move the slides 25 outwardly on the sleeves 26 and keep all slack out of the chains, holding the latter taut. The sleeves 26 are provided with spaced lines or graduations, as shown in Figs. 2 and 3, along which the outer edge of the slides 25 move and which may be used to denote pounds or horse-power.

In the drawings I illustrate a pulley-wheel 16 having two sets of dynamometer devices, one at each side thereof and coöperating therewith, and one set of said devices being shown in Fig. 1, while that at the other side of the pulley-wheel is shown in Fig. 2 and comprises the frame 18 with its radial arms 29, slide 25, sleeve 26, spring 32 and chains 27, the latter passing over the pulley-wheels 29, 30 carried by the said arms and secured at their outer ends to the flanges 22 of the wheel 16. It is to be understood, however, that I do not limit the invention to the duplication of the dynamometer devices at opposite sides of the wheel 16, since my invention is fully embodied in each set of said devices. The springs 32 are light springs and only exert sufficient power to move the slides 25 outwardly and keep the chains 27 taut.

The pulley and shaft shown in Figs. 1 and 2 may be operated in either of two ways, the dynamometer devices making the proper indications under either method of operation. The shaft 15 may be driven by power applied to it and transmit motion to the pulley-wheel 16 from which, by means of a belt, power may be transmitted to the machinery to be driven; or power may be applied to the pulley and transmitted by it to the shaft 15, whence through any suitable or usual connections said power may be transmitted to the machinery to be driven.

If power should be applied to the shaft 15, the pulley-wheel 16 being free thereon, the frames 17, 18 being fast to the shaft will be turned in a direction from the flanges 22 of the wheel 16, as shown in Fig. 1, and partly compress the springs 23 (due to the movement of the rods 21) against said flanges, and ertia of whatever is to be driven, the pulley-wheel will follow the movement of the frames 17, 18 and remain in rotation, transmitting its power, through such intermediate mechanism as may be provided, to the work. During the rotation of the frames 17, 18 and pulley-wheel 16 the graduations on the sleeves 26 will indicate the power, either in pounds or horse-power, consumed, the exact amount being indicated at the outer beveled edges of the slides 25. The position of the slides 25 will vary with the distance the ends of the radial arms of the frames 17, 18 may be from the flanges 22 of the wheel 16, and the position of said arms with relation to said flanges will vary with the resistance offered by the work to the wheel 16, the greater the resistance of the work the wider the space will be between the outer ends of the arms of the frames 17, 18 and the flanges 22. The movement of the frames 17, 18 from the flanges 22 creates a pull on the chains 27 and slides 25, the latter thereby being drawn inwardly along the sleeves 26 and denoting by their position along the graduations on said sleeves the amount of power consumed.

If the power were applied to the wheel 16 to be by it transmitted to the shaft 15 and thence from said shaft to whatever it may be desired to operate, said wheel would be rotated in a direction to carry its flanges 22 from the outer ends of the radial arms of the frames 17, 18 and against the springs 23, and after the springs 23 had under such condition become sufficiently compressed to overcome the inertia of the work, the frames 17, 18 and shaft 15 would start in motion and thereafter continue to rotate so long as adequate power remained on the wheel 16. The movement of the flanges 22 in a direction from the outer ends of the arms of the frames 17, 18 results in a pull being exerted on the chains 27 and the inward movement of the slides 25, the same as occurred in the illustration above explained in which the power instead of being applied to the wheel 16 was first applied to the shaft 15 and transmitted to said wheel.

The general purposes of dynamometers are well understood and hence require no elaborate explanation. The present dynamometer is efficient for all of the purposes for which rotative dynamometers are employed. For illustration, the engineer of a factory by observing the position of the slides 25 along the graduations of the sleeves 26 may determine therefrom whether conditions in the factory are normal or otherwise. The engineer would know in advance just about the amount of power required for the factory, and if by looking at the graduations he should see that an excess of power is being

shaft getting out of line or by a hot-bearing or by some obstruction in some part of the machinery. If the graduations indicated a consumption of less than the normal amount of power required for the work, the engineer would endeavor to ascertain what had happened to put the plant out of normal running condition, which might be caused by either a belt slipping or having become broken or by other event.

The invention is also useful in plants where power is sold, and the wheel 16 may be connected with the main line or primary shaft from which the power is transmitted to the several consumers. The friction due to the running of this main line or primary shaft might consume one horse-power, and under such condition when the said shaft is in motion, without any transmitting means from the same being connected therewith, the slides 25 would move on the sleeves 26 one space and indicate the consumption of the one horse-power. Now if a customer should require six horse-power, his belt will be connected onto the main line or primary shaft and this increased load on the wheel 16 will result in the slides 25 being moved inwardly six spaces if such customer were actually using only six horse-power. If the customer should be using eight horse-power instead of the six for which he was paying, the excess would be denoted by the position attained by the slides 25, and if he were consuming less than six horse-power that fact would also be indicated by the position of the slides 25. As many transmission belts as there may be customers may be connected with the main line or primary shaft, and if the first customer were consuming six horse-power and the slides 25 had moved to the seventh space on the sleeves 26, and the second customer desired four horse-power and obtained the same and used no greater amount, the slides 25 would then move inwardly four more spaces, indicating that both the first and second customers were consuming only the total amount of power paid for.

In Figs. 6 to 9 inclusive I illustrate my invention as embodied in a coupling comprising matching members or sections 40, 41 keyed on the respective adjoining ends of shafts 42, 43, one of which may be connected with a source of power and the other with means for giving off power. For illustration, the shaft 42 may represent an engine shaft, or water-wheel shaft, or other shaft operated by power, and the shaft 43 may represent a dynamo-shaft, a line shaft, or other shaft giving off power. The member or section 40 of the coupling is keyed upon the end of the shaft 42 and the extreme end portion of the latter preferably projects into

The section 41 is keyed on the end of the shaft 43, and the sections 40, 41 are close together and each is composed of a hub, radial arms, and a rim. On the shaft 42 is freely mounted a sleeve 44 corresponding with the sleeve 26 shown in Fig. 3, and upon this sleeve 44 is mounted a slide 45 to indicate by its position on the sleeve 44 the amount of power being consumed. The slide 45 is normally pressed outwardly on the sleeve 44 by means of light spiral springs 46 interposed between the same and a flange 47 on the inner end of the sleeve 44. The slide 45 is connected by chains 48 with flanges 49 of the coupling section 41, said chains extending from the slide 45 through the springs 46 and thence over pulley wheels 50 and thence passing in opposite directions parallel with the face of the coupling section 40 to pulley wheels 51 carried by flanges 52 integral with the coupling section 40, whence said chains pass over said pulley wheels 51 and are fastened at their ends to the aforesaid flanges 49 integral with the coupling section 41. When the sections 40, 41 of the coupling are assembled, as shown in Fig. 7, the flanges 52, 49 thereof match and pass into line with one another. Each of the flanges 52, 49 is formed with four apertures 53 and in these apertures of the flanges 52 are secured curved rods 54, corresponding with the rods 21 shown in Fig. 1, said rods 54 passing from the flanges 52 freely through the apertures 53 of the flanges 49 and being provided beyond said flanges 49 with coiled springs 55, which correspond with the springs 23 in Fig. 1.

When power is applied to the shaft 42 it will set in motion the coupling section 40, and this section will move its flanges 52 in a direction from the flanges 49 of the section 40 until the springs 55 have attained the proper degree of compression, and thereupon the coupling section 41 will follow with and be rotated by the coupling section 40 and transmit its power to the shaft 43. The movement of the flanges 52 of the coupling section 40 in a direction from the flanges 49 of the coupling section 41, results in the pulley wheels 51 drawing on the chains 48 and effecting the inward movement of the slide 45 on the graduated sleeve 44, the position of said slide on said sleeve being governed by the relation of the flanges 52 to the flanges 49. The dynamometer devices presented in Figs. 6 to 9 inclusive operate on identically the same principle as that described with respect to the devices shown in Figs. 1 to 5 inclusive and may, if desired, be used for identically the same purposes described for the construction shown in Figs. 1 to 5 inclusive, in which event the shaft 43 of Fig. 7

32 which are on the sleeves 26 intermediate the flanges 33 thereof and the inner ends of said slides. The action of the springs 32 will keep the slides 25 pressed outwardly and the chains 27 under light tension, and when the opposite radial arms of the frames 17, 18 are moved in a direction from the flanges 22, as shown in Fig. 1, said arms by moving against the chains 27 act to pull the outer ends of said chains toward the pulley-wheel 16, thereby causing the slides 25 to move inwardly along the sleeves 26 under the opposition of the springs 32. When the opposite radial arms of the frames 17, 18 move in a direction toward the flanges 22 they gradually release their pressure on the chains 27 and the springs 32, at such times, move the slides 25 outwardly on the sleeves 26 and keep all slack out of the chains, holding the latter taut. The sleeves 26 are provided with spaced lines or graduations, as shown in Figs. 2 and 3, along which the outer edge of the slides 25 move and which may be used to denote pounds or horse-power.

In the drawings I illustrate a pulley-wheel 16 having two sets of dynamometer devices, one at each side thereof and coöperating therewith, and one set of said devices being shown in Fig. 1, while that at the other side of the pulley-wheel is shown in Fig. 2 and comprises the frame 18 with its radial arms 20, slide 25, sleeve 26, spring 32 and chains 27, the latter passing over the pulley-wheels 29, 30 carried by the said arms and secured at their outer ends to the flanges 22 of the wheel 16. It is to be understood, however, that I do not limit the invention to the duplication of the dynamometer devices at opposite sides of the wheel 16, since my invention is fully embodied in each set of said devices. The springs 32 are light springs and only exert sufficient power to move the slides 25 outwardly and keep the chains 27 taut.

The pulley and shaft shown in Figs. 1 and 2 may be operated in either of two ways, the dynamometer devices making the proper indications under either method of operation. The shaft 15 may be driven by power applied to it and transmit motion to the pulley-wheel 16 from which, by means of a belt, power may be transmitted to the machinery to be driven; or power may be applied to the pulley and transmitted by it to the shaft 15, whence through any suitable or usual connections said power may be transmitted to the machinery to be driven.

If power should be applied to the shaft 15, the pulley-wheel 16 being free thereon, the frames 17, 18 being fast to the shaft will be turned in a direction from the flanges 22 of the wheel 16, as shown in Fig. 1, and partly compress the springs 23 (due to the movement of the rods 21) against said flanges, and thereupon after the springs 23 have been sufficiently compressed to overcome the inertia of whatever is to be driven, the pulley-wheel will follow the movement of the frames 17, 18 and remain in rotation, transmitting its power, through such intermediate mechanism as may be provided, to the work. During the rotation of the frames 17, 18 and pulley-wheel 16 the graduations on the sleeves 26 will indicate the power, either in pounds or horse-power, consumed, the exact amount being indicated at the outer beveled edges of the slides 25. The position of the slides 25 will vary with the distance the ends of the radial arms of the frames 17, 18 may be from the flanges 22 of the wheel 16, and the position of said arms with relation to said flanges will vary with the resistance offered by the work to the wheel 16, the greater the resistance of the work the wider the space will be between the outer ends of the arms of the frames 17, 18 and the flanges 22. The movement of the frames 17, 18 from the flanges 22 creates a pull on the chains 27 and slides 25, the latter thereby being drawn inwardly along the sleeves 26 and denoting by their position along the graduations on said sleeves the amount of power consumed.

If the power were applied to the wheel 16 to be by it transmitted to the shaft 15 and thence from said shaft to whatever it may be desired to operate, said wheel would be rotated in a direction to carry its flanges 22 from the outer ends of the radial arms of the frames 17, 18 and against the springs 23, and after the springs 23 had under such condition become sufficiently compressed to overcome the inertia of the work, the frames 17, 18 and shaft 15 would start in motion and thereafter continue to rotate so long as adequate power remained on the wheel 16. The movement of the flanges 22 in a direction from the outer ends of the arms of the frames 17, 18 results in a pull being exerted on the chains 27 and the inward movement of the slides 25, the same as occurred in the illustration above explained in which the power instead of being applied to the wheel 16 was first applied to the shaft 15 and transmitted to said wheel.

The general purposes of dynamometers are well understood and hence require no elaborate explanation. The present dynamometer is efficient for all of the purposes for which rotative dynamometers are employed. For illustration, the engineer of a factory by observing the position of the slides 25 along the graduations of the sleeves 26 may determine therefrom whether conditions in the factory are normal or otherwise. The engineer would know in advance just about the amount of power required for the factory, and if by looking at the graduations he should see that an excess of power is being consumed, he would be led to find the cause of this condition, which might be due to a

shaft getting out of line or by a hot-bearing or by some obstruction in some part of the machinery. If the graduations indicated a consumption of less than the normal amount of power required for the work, the engineer would endeavor to ascertain what had happened to put the plant out of normal running condition, which might be caused by either a belt slipping or having become broken or by other event.

The invention is also useful in plants where power is sold, and the wheel 16 may be connected with the main line or primary shaft from which the power is transmitted to the several consumers. The friction due to the running of this main line or primary shaft might consume one horse-power, and under such condition when the said shaft is in motion, without any transmitting means from the same being connected therewith, the slides 25 would move on the sleeves 26 one space and indicate the consumption of the one horse-power. Now if a customer should require six horse-power, his belt will be connected onto the main line or primary shaft and this increased load on the wheel 16 will result in the slides 25 being moved inwardly six spaces if such customer were actually using only six horse-power. If the customer should be using eight horse-power instead of the six for which he was paying, the excess would be denoted by the position attained by the slides 25, and if he were consuming less than six horse-power that fact would also be indicated by the position of the slides 25. As many transmission belts as there may be customers may be connected with the main line or primary shaft, and if the first customer were consuming six horse-power and the slides 25 had moved to the seventh space on the sleeves 26, and the second customer desired four horse-power and obtained the same and used no greater amount, the slides 25 would then move inwardly four more spaces, indicating that both the first and second customers were consuming only the total amount of power paid for.

In Figs. 6 to 9 inclusive I illustrate my invention as embodied in a coupling comprising matching members or sections 40, 41 keyed on the respective adjoining ends of shafts 42, 43, one of which may be connected with a source of power and the other with means for giving off power. For illustration, the shaft 42 may represent an engine shaft, or water-wheel shaft, or other shaft operated by power, and the shaft 43 may represent a dynamo-shaft, a line shaft, or other shaft giving off power. The member or section 40 of the coupling is keyed upon the end of the shaft 42 and the extreme end portion of the latter preferably projects into but is not keyed with the hub of the coupling member or section 41, as shown in Fig. 7. The section 41 is keyed on the end of the shaft 43, and the sections 40, 41 are close together and each is composed of a hub, radial arms, and a rim. On the shaft 42 is freely mounted a sleeve 44 corresponding with the sleeve 26 shown in Fig. 3, and upon this sleeve 44 is mounted a slide 45 to indicate by its position on the sleeve 44 the amount of power being consumed. The slide 45 is normally pressed outwardly on the sleeve 44 by means of light spiral springs 46 interposed between the same and a flange 47 on the inner end of the sleeve 44. The slide 45 is connected by chains 48 with flanges 49 of the coupling section 41, said chains extending from the slide 45 through the springs 46 and thence over pulley wheels 50 and thence passing in opposite directions parallel with the face of the coupling section 40 to pulley wheels 51 carried by flanges 52 integral with the coupling section 40, whence said chains pass over said pulley wheels 51 and are fastened at their ends to the aforesaid flanges 49 integral with the coupling section 41. When the sections 40, 41 of the coupling are assembled, as shown in Fig. 7, the flanges 52, 49 thereof match and pass into line with one another. Each of the flanges 52, 49 is formed with four apertures 53 and in these apertures of the flanges 52 are secured curved rods 54, corresponding with the rods 21 shown in Fig. 1, said rods 54 passing from the flanges 52 freely through the apertures 53 of the flanges 49 and being provided beyond said flanges 49 with coiled springs 55, which correspond with the springs 23 in Fig. 1.

When power is applied to the shaft 42 it will set in motion the coupling section 40, and this section will move its flanges 52 in a direction from the flanges 49 of the section 40 until the springs 55 have attained the proper degree of compression, and thereupon the coupling section 41 will follow with and be rotated by the coupling section 40 and transmit its power to the shaft 43. The movement of the flanges 52 of the coupling section 40 in a direction from the flanges 49 of the coupling section 41, results in the pulley wheels 51 drawing on the chains 48 and effecting the inward movement of the slide 45 on the graduated sleeve 44, the position of said slide on said sleeve being governed by the relation of the flanges 52 to the flanges 49. The dynamometer devices presented in Figs. 6 to 9 inclusive operate on identically the same principle as that described with respect to the devices shown in Figs. 1 to 5 inclusive and may, if desired, be used for identically the same purposes described for the construction shown in Figs. 1 to 5 inclusive, in which event the shaft 43 of Fig. 7 would represent the main line or primary shaft and the shaft 42 an engine or motor shaft.

The construction shown in Figs. 6 to 9 inclusive will be found convenient of use for direct connection, and that shown in Figs. 1 to 5 inclusive for belt or indirect connection.

What I claim as my invention and desire to secure by Letters Patent, is:

1. A dynamometer comprising a rotary shaft, a rotary member secured thereon, a second rotary member, and a yielding spring connection between said members, whereby one may start in advance of and finally communicate motion to the other, combined with a slide on said shaft to indicate by its position the power consumed, a graduated scale along the path of said slide, and flexible connections leading from opposite sides of said slide around oppositely disposed portions of said member on the shaft to opposite portions of said second member; substantially as set forth.

2. A dynamometer comprising a rotary shaft, a rotary member secured thereon, a second rotary member, and a yielding spring connection between said members, whereby one may start in advance of and finally communicate motion to the other, combined with a slide on said shaft to indicate by its position the power consumed, a sleeve on said shaft within said slide having graduation scale marks along the path of said slide, a spring on said sleeve confined against said slide and normally acting to maintain said slide in its initial position, and flexible connections leading from opposite sides of said slide around oppositely disposed portions of said member on the shaft to opposite portions of said second member; substantially as set forth.

3. A dynamometer comprising a rotary shaft, a rotary member secured thereon having a hub, spokes and rim, a second rotary member on said shaft having a hub and radial arms, spring connections between said arms and adjacent portions of said member secured on the shaft, whereby one member may start in advance of and finally communicate its motion to the other member, combined with a slide on said shaft to indicate by its position the power consumed, a graduated scale along the path of said slide, and flexible connections leading from opposite sides of said slide around oppositely disposed portions of said member on the shaft to opposite portions of said second member; substantially as set forth.

4. A dynamometer comprising a rotary shaft, a rotary member secured thereon having a hub, spokes and rim, a second rotary member on said shaft having a hub and radial arms, curved rods carried by said arms and extending freely through apertures in adjacent portions of said member secured on the shaft and coiled springs on said rods beyond and bearing against such adjacent portions, whereby one of said members may start in advance of and finally communicate its motion to the other member, combined with a slide on said shaft to indicate by its position the power consumed, a sleeve on said shaft within said slide having graduation scale marks along the path of said slide, a spring on said sleeve confined against said slide and normally acting to maintain said slide in its initial position, and flexible connections leading from opposite sides of said slide around oppositely disposed portions of said member on the shaft to opposite portions of said second member; substantially as set forth,

Signed at New York city, in the county of New York, and State of New York, this 1st day of April A. D. 1908.

THOMAS R. MOORE.

Witnesses:

ARTHUR MARION,

CHAS. C. GILL.

H. B. BYRON.

METHOD OF MAKING PHONOGRAPHIC RECORDS.

APPLICATION FILED FEB. 19, 1912.

1,185,056.

Patented May 30, 1916.

2 SHEETS—SHEET 1.

Fig. 1.

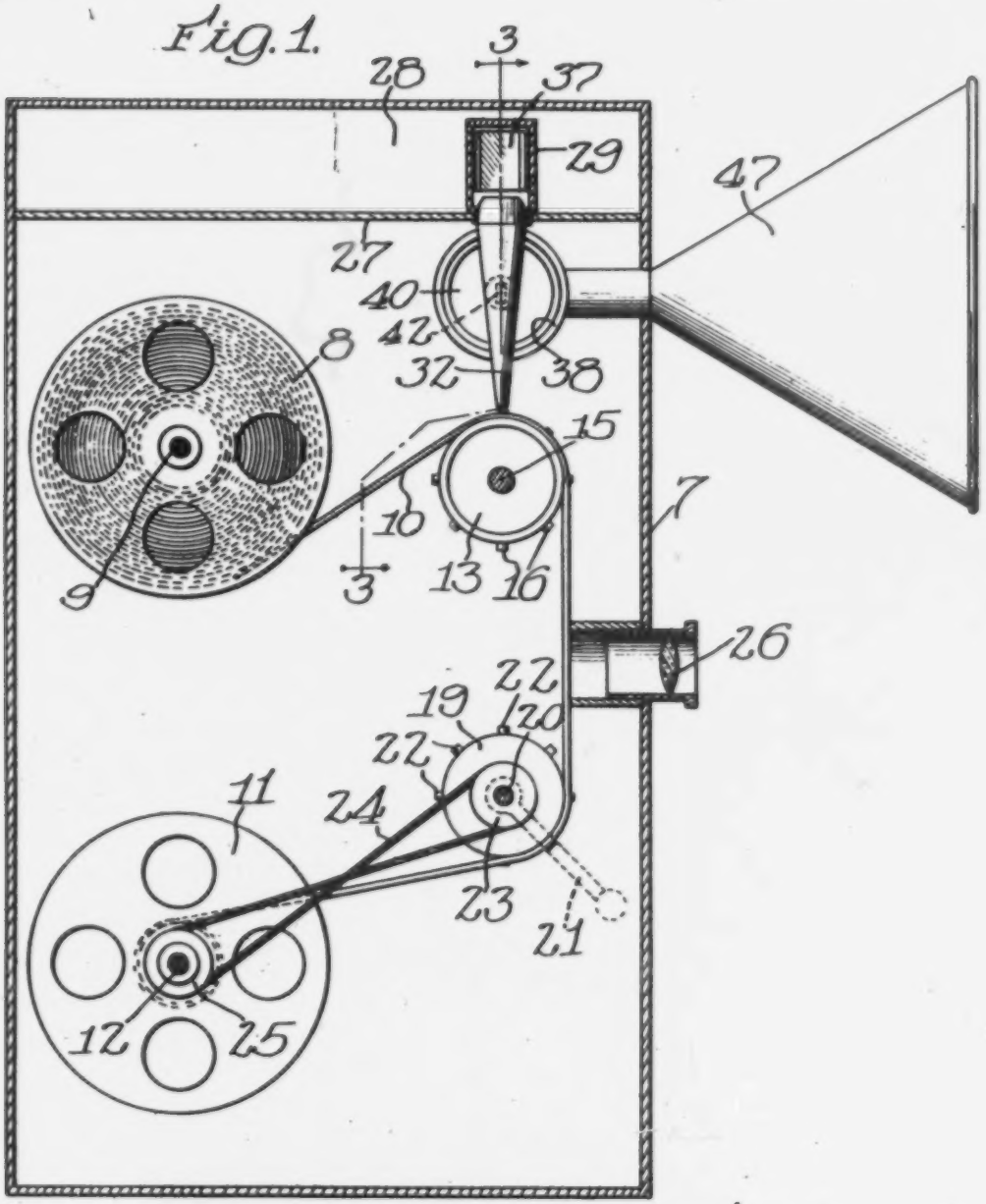
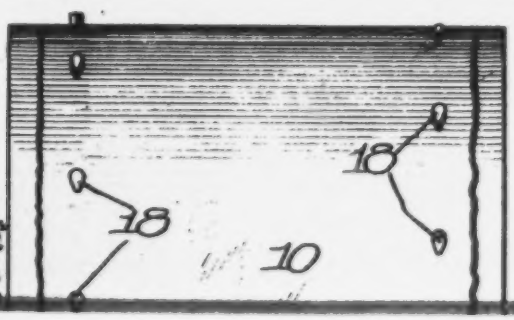


Fig. 2.



Witnesses:

Inventor:

METHOD OF MAKING PHONOGRAPHIC RECORDS.

APPLICATION FILED FEB. 19, 1912.

1,185,056.

Patented May 30, 1916.

2 SHEETS—SHEET 1.

Fig. 1.

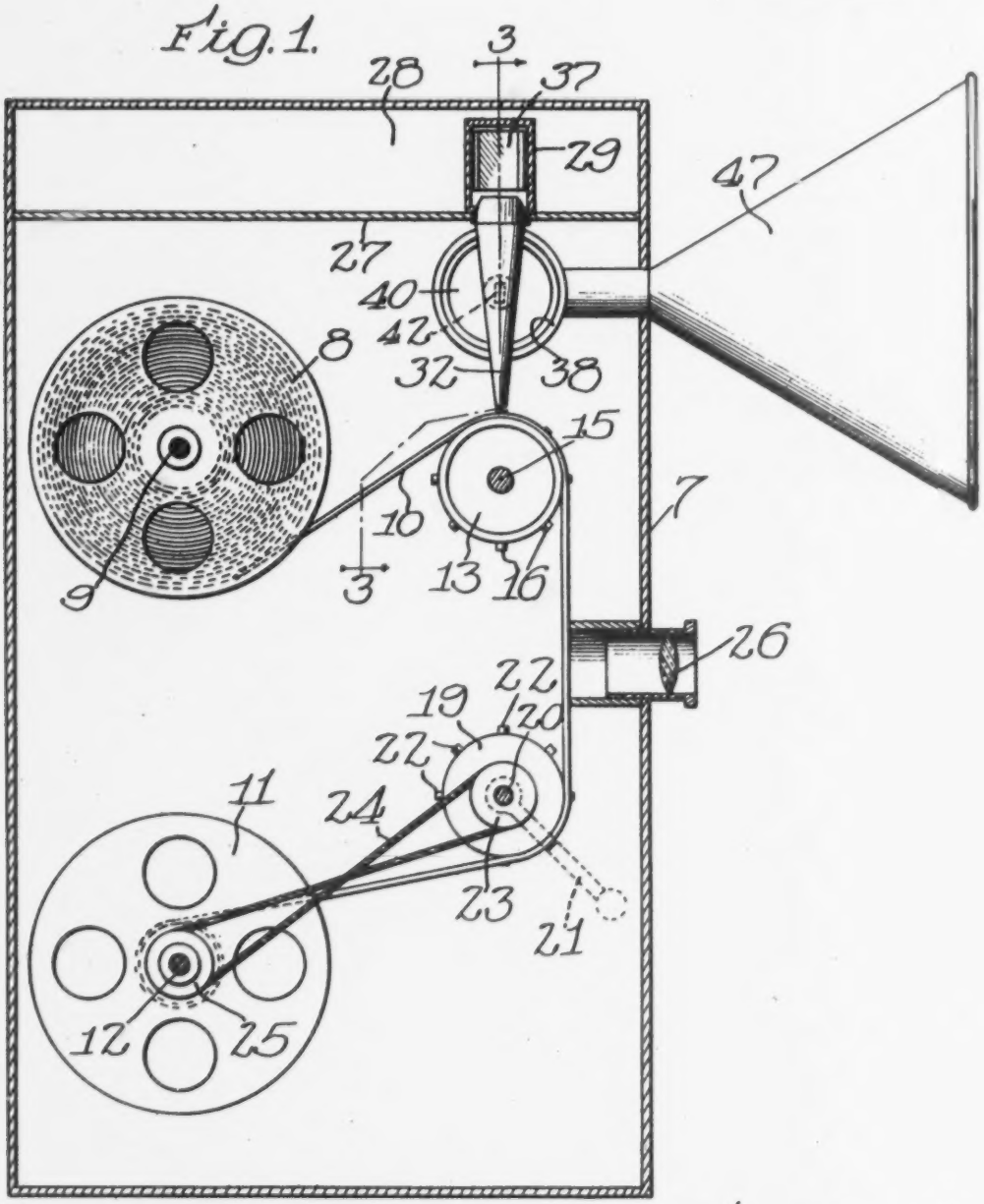
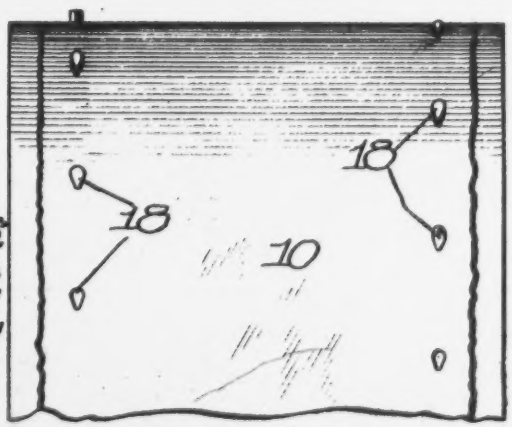


Fig. 2.



Witnesses:
E. W. Bomar Jr.
R. Burkhardt.

Inventor:
Hagar Bolton Byrom,
by Wood Herron Pickering & Evans.
Attys.

148

H. B. BYRON.

METHOD OF MAKING PHONOGRAPHIC RECORDS.

APPLICATION FILED FEB. 19, 1912.

1,185,056.

Patented May 30, 1916.

2 SHEETS—SHEET 2.

Fig. 3.

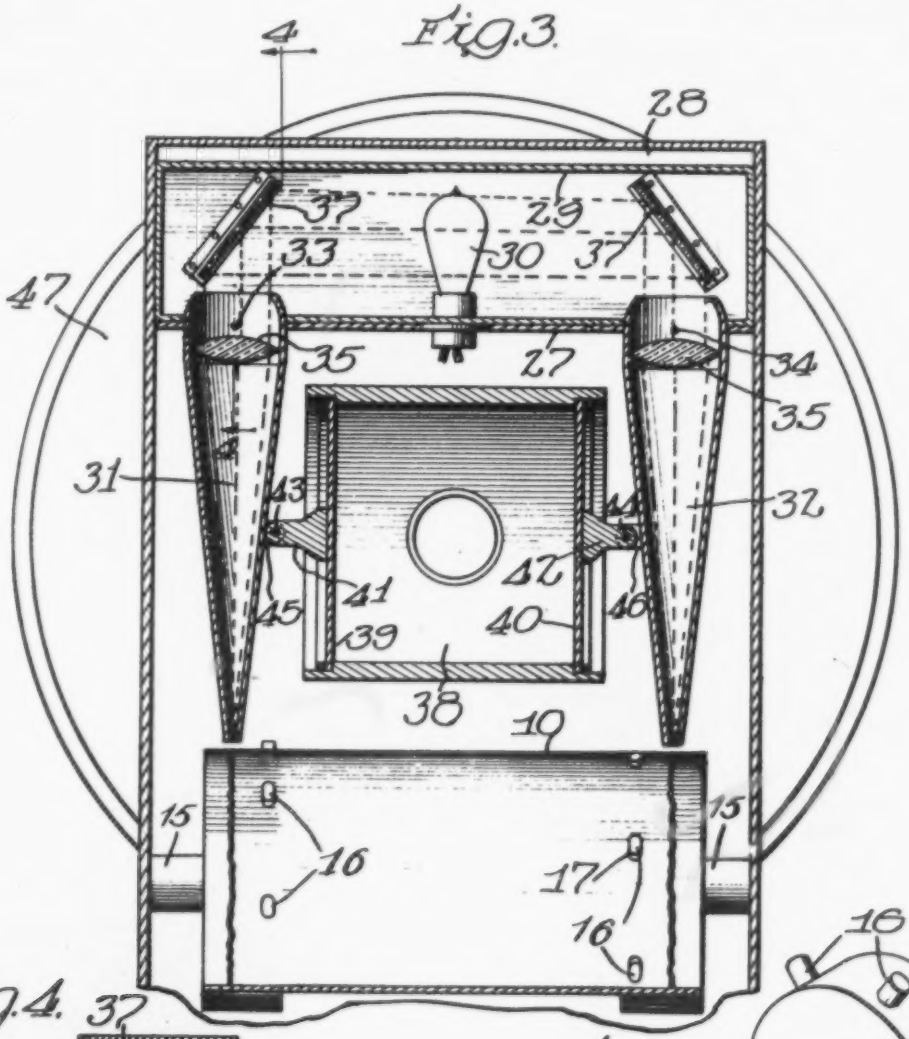


Fig. 4.

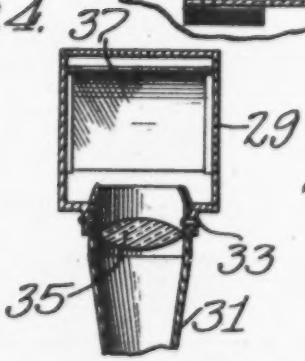


Fig. 5.

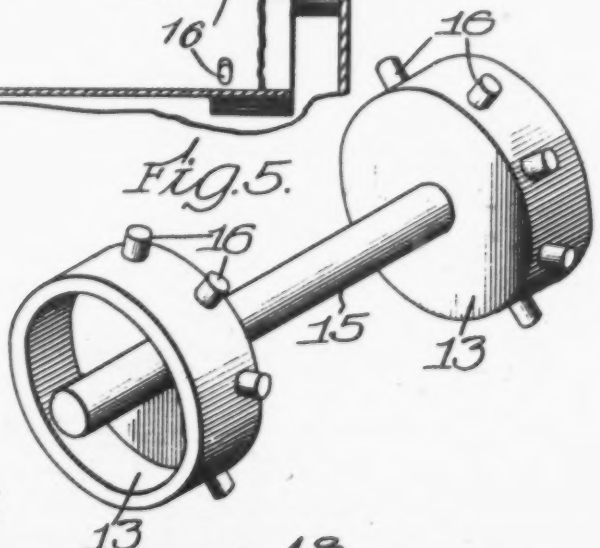


Fig. 6.

Witnesses:

Inventor

UNITED STATES PATENT OFFICE.

HAGAR BOLTON BYRON, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, OF ONE-THIRD TO A. H. ADAMS, ADA R. PICKARD, AND J. L. JACKSON, OF CHICAGO, ILLINOIS.

METHOD OF MAKING PHONOGRAPHIC RECORDS.

1,185,056. Specification of Letters Patent. Patented May 30, 1916.

Application filed February 19, 1912. Serial No. 678,610.

To all whom it may concern:

Be it known that I, HAGAR BOLTON BYRON, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and Improved Method of Making Phonographic Records, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to the art of making phonographic records for the reproduction of sounds, and has for its object to provide a new and improved method by which continuous records of any desired length may be made having one or more grooves corresponding with the sound waves to be reproduced; also to provide for making such sound grooves by photography and thus make practicable the simultaneous making of sound records and photographic records on the same medium, such as a flexible film, thereby insuring perfect synchronism. I accomplish these objects as illustrated in the drawings and as hereinafter described.

What I regard as new is set forth in the claims.

In the accompanying drawings,—Figure 1 is a vertical sectional view showing one form of apparatus that may be conveniently employed for photographing sound waves upon a continuous film and at the same time photographing views thereon; Fig. 2 is an enlarged detail, showing the face view of a portion of a combined phonographic and kinetographic record as made by such apparatus; Fig. 3 is an enlarged detail, being a partial vertical cross-section on line 3—3 of Fig. 1; Fig. 4 is an enlarged detail, being a partial vertical section on line 4—4 of Fig. 3; Fig. 5 is a perspective view of the guide wheels and shaft; and Fig. 6 is a cross-section of the finished record.

My invention contemplates the exposure of a sensitive ribbon or film to the action of light so that when developed it will form a negative of the sounds to be reproduced, the latter being manifested in the form of lateral wave lines corresponding to the sound waves accompanying the exposure. In the best form of my invention, two sound wave lines are produced near the opposite margins not be as satisfactory as if two of such wave lines are made. By providing two sound wave lines one will be apt to make up for any deficiency in the other, so that uniformly good results will be obtained, and moreover, the life of the film is prolonged, as the wear upon each sound wave line is not as great, since they coöperate in sound reproduction. After the development of the film in the usual way, a positive film is produced from it, in which, of course, the lights and shadows are reversed, the sound wave lines being unaffected by the light. In making this positive film, when a combined kinetographic and phonographic record is to be produced, I employ a film the intermediate portion of which is sensitized in the same way as the ordinary photographic film, while its margins are coated with a soluble composition capable of being hardened or rendered water-insoluble by the action of light, such as an emulsion composed of one-fifth gelatin, one-fifth bichromate of potash, and three-fifths gum arabic. These proportions may, however, be varied, and instead of the composition mentioned any other composition suitable for the purpose may be employed. This film having the marginal zones described is exposed to light under the negative film in the usual way, and is then developed, fixed and washed according to the procedure usually followed with kinetographic films. Those portions of the marginal zones which are exposed to light become insoluble, but the portions underlying the negative sound wave lines, being unaffected by the light, remain soluble in water and are consequently dissolved and washed away in the finishing of the film, as described, thereby leaving channels or grooves which correspond exactly with the sinuosities of the negative sound wave lines and are capable of sound reproduction by the use of any suitable phonographic reproducing apparatus operating by lateral vibration, such as that used in the instrument known as the "gramophone", or other similar devices operating on disk records. These thickened marginal portions of the film also serve another purpose in that the film is thus provided with a depressed intermediate portion

METHOD OF MAKING PHONOGRAPHIC RECORDS.

APPLICATION FILED FEB. 19, 1912.

1,185,056.

Patented May 30, 1916.

2 SHEETS—SHEET 2.

Fig. 3.

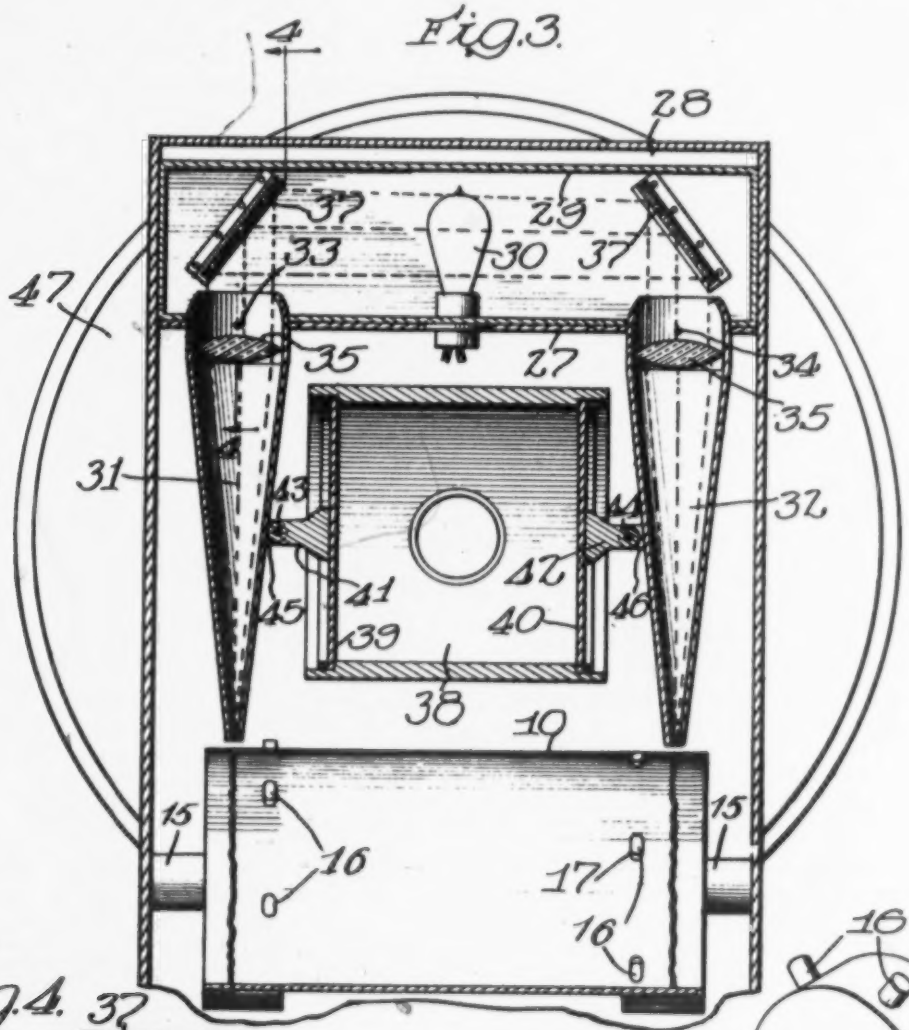


Fig. 4.

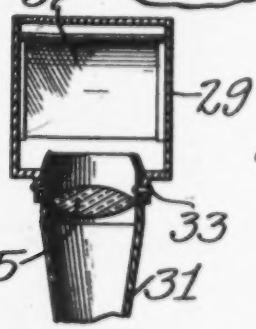


Fig. 5.

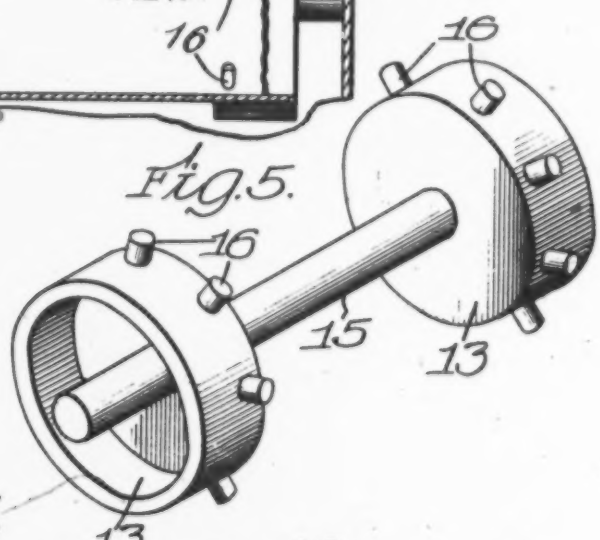
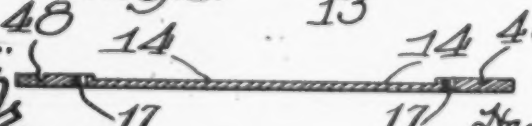


Fig. 6.



Witnesses:
G. K. Bowers Jr.
A. Burkhardt.

Inventor
Hagar Bolton Byron,
by Bond & Adams Pickard & Jaeger,
Attys.

HAGAR BOLTON BYRON, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, OF ONE-THIRD TO A. H. ADAMS, ADA E. PICKARD, AND J. L. JACKSON, OF CHICAGO, ILLINOIS.

METHOD OF MAKING PHONOGRAPHIC RECORDS.

1,185,056. Specification of Letters Patent. Patented May 30, 1916.

Application filed February 19, 1912. Serial No. 678,610.

To all whom it may concern:

Be it known that I, HAGAR BOLTON BYRON, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and Improved Method of Making Phonographic Records, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to the art of making phonographic records for the reproduction of sounds, and has for its object to provide a new and improved method by which continuous records of any desired length may be made having one or more grooves corresponding with the sound waves to be reproduced; also to provide for making such sound grooves by photography and thus make practicable the simultaneous making of sound records and photographic records on the same medium, such as a flexible film, thereby insuring perfect synchronism. I accomplish these objects as illustrated in the drawings and as hereinafter described.

What I regard as new is set forth in the claims.

In the accompanying drawings,—Figure 1 is a vertical sectional view showing one form of apparatus that may be conveniently employed for photographing sound waves upon a continuous film and at the same time photographing views thereon; Fig. 2 is an enlarged detail, showing the face view of a portion of a combined phonographic and kinetographic record as made by such apparatus; Fig. 3 is an enlarged detail, being a partial vertical cross-section on line 3—3 of Fig. 1; Fig. 4 is an enlarged detail, being a partial vertical section on line 4—4 of Fig. 3; Fig. 5 is a perspective view of the guide wheels and shaft; and Fig. 6 is a cross-section of the finished record.

My invention contemplates the exposure of a sensitive ribbon or film to the action of light so that when developed it will form a negative of the sounds to be reproduced, the latter being manifested in the form of lateral wave lines corresponding to the sound waves accompanying the exposure. In the best form of my invention, two sound wave lines are produced near the opposite margins of the film, which in the embodiment illustrated are thickened, but my invention is not restricted to making two of such wave lines, as one will suffice, although the results will not be as satisfactory as if two of such wave lines are made. By providing two sound wave lines one will be apt to make up for any deficiency in the other, so that uniformly good results will be obtained, and moreover, the life of the film is prolonged, as the wear upon each sound wave line is not as great, since they coöperate in sound reproduction. After the development of the film in the usual way, a positive film is produced from it, in which, of course, the lights and shadows are reversed, the sound wave lines being unaffected by the light. In making this positive film, when a combined kinetographic and phonographic record is to be produced, I employ a film the intermediate portion of which is sensitized in the same way as the ordinary photographic film, while its margins are coated with a soluble composition capable of being hardened or rendered water-insoluble by the action of light, such as an emulsion composed of one-fifth gelatin, one-fifth bichromate of potash, and three-fifths gum arabic. These proportions may, however, be varied, and instead of the composition mentioned any other composition suitable for the purpose may be employed. This film having the marginal zones described is exposed to light under the negative film in the usual way, and is then developed, fixed and washed according to the procedure usually followed with kinetographic films. Those portions of the marginal zones which are exposed to light become insoluble, but the portions underlying the negative sound wave lines, being unaffected by the light, remain soluble in water and are consequently dissolved and washed away in the finishing of the film, as described, thereby leaving channels or grooves which correspond exactly with the sinuosities of the negative sound wave lines and are capable of sound reproduction by the use of any suitable phonographic reproducing apparatus operating by lateral vibration, such as that used in the instrument known as the "gramophone", or other similar devices operating on disk records. These thickened marginal portions of the film also serve another purpose in that the film is thus provided with a depressed intermediate portion which receives the kinetographic picture records, which, by this means are protected from pressure when the film is rolled on the spool or reel, thereby protecting them from

abrasion or scratching. This feature is, however, not herein claimed, but is reserved for incorporation in a separate application. The combined kinetographic and phonographic record when used for reproduction purposes, is run through an apparatus having phonographic reproducing means and picture projecting mechanism arranged in the same relative positions as in the apparatus used in making the negative, so that the sounds and views are reproduced with perfect synchronism. It will be understood, of course, that the method described may be used for producing sound records only as well as for producing combined kinetographic and phonographic records.

Referring now to the drawings for a description of the apparatus therein shown,—7 indicates a camera or light-proof box of suitable size and shape to inclose the reels on which the film is wound, and the sound-reproducing apparatus.

8 indicates a reel mounted on a suitable shaft 9, said reel being designed to carry the unexposed film.

10 indicates the negative film, and 11 indicates the rewinding reel mounted on a shaft 12.

13 indicates a pair of guide pulleys mounted on a shaft 15 and arranged adjacent to the reel 8, the shaft 15 being parallel with the shaft 9. The pulleys 13 are provided on their upper surface with a series of pins or sprockets 16 which engage perforations 17 near the margins of the film 10. For the purpose of insuring proper registration of the film, the perforations 17 are rounded at their forward margins and preferably are made elliptical, and the sprockets 16 are correspondingly shaped. If desired, said perforations may be made more or less kite-shaped, with rounded apices at the front or leading portions thereof, as shown at 16 in Fig. 2. The purpose of this arrangement is to provide against lateral movement of the film, since by making the perforations round or somewhat V-shaped at their forward or leading portions and operating them by correspondingly shaped sprockets, the film is held against lateral displacement and its proper alinement is maintained.

19 indicates a pair of drive-wheels similar to the pulleys 13 and mounted on a shaft 20 parallel with the shaft 15. The shaft 20 extends through one side of the camera 7 and is provided with a crank 21 for rotating it. The wheels 19 also have sprockets 22 similar to the sprockets 16. In order to secure a more uniform movement of the film under the action of the drive-wheels 19, the sprockets on the two wheels of each pair, are staggered with relation to each other, and the perforations in the opposite Fig. 3. The shaft 20 is also provided with a pulley 23 connected by any suitable belt 24 with a pulley 25 on the shaft 12 of the rewinding reel 11. By this construction by rotating the drive-wheels 19 by means of the crank 21, the film 10 is unrolled from the reel 18, and after passing around the pulleys 13 and the drive-wheels 19, is rewound on the reel 11.

26 indicates a conventional representation of a photographic lens arranged adjacent to that part of the film extending between the pulleys 13 and drive-wheels 19. It will be understood that the lens 26 is provided with the usual shutter mechanism required for kinetographic work. The lens is preferably one having the construction shown and described in my application filed Feb. 16, 1912, Serial No. 677,233 for method of and apparatus for producing a round or relief effect by photography.

27 indicates a partition which extends across the upper portion of the camera 7, forming an upper compartment 28.

29 indicates a box or housing which is arranged in the compartment 28 and extends transversely thereof at a point centrally over the pulleys 13. Said box is light tight and contains an incandescent lamp 30, or other suitable source of light.

31—32 indicate two funnel-shaped tubes, the upper and larger ends of which extend up through the partition 27 into the box 29 near the ends thereof and are pivotally mounted on pivots 33—34 which are arranged to permit the tubes 31—32 to swing transversely of the camera. The tubes 31—32 are tapered practically to a point at their lower ends so as to leave a minute passage at their lower ends, the arrangement being such that such passages lie over and adjacent to the marginal portions of the film, as best shown in Fig. 3. In the illustration the lower ends of the tubes 31—32 are shown as somewhat removed from the film for clearness of illustration, but in practice they approximate very closely to the film. The tubes 31—32 are provided at their upper ends with lenses 35, the purpose of which is to focus the light at the lower ends of the tubes.

37 indicates mirrors mounted at the ends of the box 29 in oppositely-inclined positions so as to reflect the light coming from the lamp 30 upon the upper surfaces of the lenses 35, as indicated by dotted lines in Fig. 3. By this construction the light coming from the lamp 30 is concentrated and directed upon the marginal portions of the film 10 so that if the tubes 31—32 were allowed to remain stationary the movement of the film 10 through the camera would result in exposing the marginal portions of

negative. In order, however, to make these lines of exposure correspond with sound waves, the tubes 31—32 are caused to swing sidewise in conformity to sound wave vibrations and so correspondingly modify the contour of the lines in the marginal portions of the film caused by the exposure. For this purpose, I employ a sound box 38 placed between the tubes 31—32 and having at its ends vibrating diaphragms 39—40 which are connected, respectively, with the tubes 31—32. In the construction illustrated these connections are made by means of beams 41—42 secured to the diaphragms 39—40, respectively, and connected by pivots 43—44 with lugs 45—46 carried by the tubes 31—32, respectively, as shown in Fig. 3.

47 indicates a horn connected with the sound-box 38. Thus the vibrations of the diaphragms 39—40 under the action of sound waves cause a corresponding vibration or movement of the tubes 31—32, which is magnified because of the projection of said tubes below the point of their connection with the diaphragms. This effects the vibration of the beams of light directed upon the marginal portions of the film so that the exposures thereof correspond exactly in outline with the sound waves which produce them. After the negative film has been exposed, it is developed in the usual way and is then used to make a positive film in the manner already described.

As shown in Fig. 6, the positive film 14, when completed, has the photographic views on the intermediate sunken portion and phonographic record grooves 48 in its marginal portions, the latter being susceptible of reproducing sound by lateral vibrations of a reproducing needle in the ordinary way. The apparatus for reproducing the sound may be similar to the record making apparatus, except that needles are substituted for the tubes 31—32, but any approved reproducing apparatus may be employed.

While my invention is peculiarly applicable to the production of combined kinetographic and phonographic records, it is equally applicable to the reproduction of sound records only, in which case the films would be of appropriate dimensions and the apparatus employed would also be suitably modified.

That which I claim as my invention, and desire to secure by Letters Patent, is,—

1. The method of making sound records, which consists in forming a negative wave line corresponding with sound waves, by photography, making a positive from such negative on a separate film capable of being hardened by the action of light, and removing the unexposed material.

2. The method of making sound records, which consists in forming a negative wave line corresponding with sound waves, by photography, making a positive from such negative on a separate film composed of a gelatin emulsion containing bichromate of potash, and then removing the unexposed material to form a groove corresponding with the sound wave line.

3. The method of making sound records, which consists in forming a negative wave line corresponding with sound waves, by photography, making a positive from such negative on a separate film composed of an emulsion composed of gelatin, gum arabic and bichromate of potash, and then removing the unexposed material to form a groove corresponding with the sound wave line.

4. The method of making sound records, which consists in forming a negative wave line by photography, corresponding with sound waves, then forming from the negative a positive record by printing on a separate film having a marginal zone composed of material capable of being hardened by the action of light, and then removing the unexposed material.

5. The method of making sound records, which consists in kinetographically producing upon a moving film a negative wave line corresponding with sound waves, and then forming a positive record from such negative film by printing therefrom upon a separate film capable of being hardened by the action of light, and removing the unexposed material.

HAGAR BOLTON BYRON.

Witnesses:
JOHN L. JACKSON,
MINNIE A. HUNTER.

however, not herein claimed, but is reserved for incorporation in a separate application. The combined kinetographic and phonographic record when used for reproduction purposes, is run through an apparatus having phonographic reproducing means and picture projecting mechanism arranged in the same relative positions as in the apparatus used in making the negative, so that the sounds and views are reproduced with perfect synchronism. It will be understood, of course, that the method described may be used for producing sound records only as well as for producing combined kinetographic and phonographic records.

Referring now to the drawings for a description of the apparatus therein shown,—

7 indicates a camera or light-proof box of suitable size and shape to inclose the reels on which the film is wound, and the sound-reproducing apparatus.

8 indicates a reel mounted on a suitable shaft 9, said reel being designed to carry the unexposed film.

10 indicates the negative film, and 11 indicates the rewinding reel mounted on a shaft 12.

13 indicates a pair of guide pulleys mounted on a shaft 15 and arranged adjacent to the reel 8, the shaft 15 being parallel with the shaft 9. The pulleys 13 are provided on their upper surface with a series of pins or sprockets 16 which engage perforations 17 near the margins of the film 10. For the purpose of insuring proper registration of the film, the perforations 17 are rounded at their forward margins and preferably are made elliptical, and the sprockets 16 are correspondingly shaped. If desired, said perforations may be made more or less kite-shaped, with rounded apices at the front or leading portions thereof, as shown at 18 in Fig. 2. The purpose of this arrangement is to provide against lateral movement of the film, since by making the perforations round or somewhat V-shaped at their forward or leading portions and operating them by correspondingly shaped sprockets, the film is held against lateral displacement and its proper alinement is maintained.

19 indicates a pair of drive-wheels similar to the pulleys 13 and mounted on a shaft 20 parallel with the shaft 15. The shaft 20 extends through one side of the camera 7 and is provided with a crank 21 for rotating it. The wheels 19 also have sprockets 22 similar to the sprockets 16. In order to secure a more uniform movement of the film under the action of the drive-wheels 19, the sprockets on the two wheels of each pair, are staggered with relation to each other, and the perforations in the opposite marginal portions of the film bear a staggered relation to each other, as shown in a pulley 23 connected by any suitable belt 24 with a pulley 25 on the shaft 12 of the rewinding reel 11. By this construction by rotating the drive-wheels 19 by means of the crank 21, the film 10 is unrolled from the reel 18, and after passing around the pulleys 13 and the drive-wheels 19, is rewound on the reel 11.

26 indicates a conventional representation of a photographic lens arranged adjacent to that part of the film extending between the pulleys 13 and drive-wheels 19. It will be understood that the lens 26 is provided with the usual shutter mechanism required for kinetographic work. The lens is preferably one having the construction shown and described in my application filed Feb. 16, 1912, Serial No. 677,233 for method of and apparatus for producing a round or relief effect by photography.

27 indicates a partition which extends across the upper portion of the camera 7, forming an upper compartment 28.

29 indicates a box or housing which is arranged in the compartment 28 and extends transversely thereof at a point centrally over the pulleys 13. Said box is light tight and contains an incandescent lamp 30, or other suitable source of light.

31—32 indicate two funnel-shaped tubes, the upper and larger ends of which extend up through the partition 27 into the box 29 near the ends thereof and are pivotally mounted on pivots 33—34 which are arranged to permit the tubes 31—32 to swing transversely of the camera. The tubes 31—32 are tapered practically to a point at their lower ends so as to leave a minute passage at their lower ends, the arrangement being such that such passages lie over and adjacent to the marginal portions of the film, as best shown in Fig. 3. In the illustration the lower ends of the tubes 31—32 are shown as somewhat removed from the film for clearness of illustration, but in practice they approximate very closely to the film. The tubes 31—32 are provided at their upper ends with lenses 35, the purpose of which is to focus the light at the lower ends of the tubes.

37 indicates mirrors mounted at the ends of the box 29 in oppositely-inclined positions so as to reflect the light coming from the lamp 30 upon the upper surfaces of the lenses 35, as indicated by dotted lines in Fig. 3. By this construction the light coming from the lamp 30 is concentrated and directed upon the marginal portions of the film 10 so that if the tubes 31—32 were allowed to remain stationary the movement of the film 10 through the camera would result in exposing the marginal portions of the film to light along two straight lines, which would show black on the developed

negative. In order, however, to make these lines of exposure correspond with sound waves, the tubes 31—32 are caused to swing sidewise in conformity to sound wave vibrations and so correspondingly modify the contour of the lines in the marginal portions of the film caused by the exposure. For this purpose, I employ a sound box 38 placed between the tubes 31—32 and having at its ends vibrating diaphragms 39—40 which are connected, respectively, with the tubes 31—32. In the construction illustrated these connections are made by means of bosses 41—42 secured to the diaphragms 39—40, respectively, and connected by pivots 43—44 with lugs 45—46 carried by the tubes 31—32, respectively, as shown in Fig. 3.

47 indicates a horn connected with the sound-box 38. Thus the vibrations of the diaphragms 39—40 under the action of sound waves cause a corresponding vibration or movement of the tubes 31—32, which is magnified because of the projection of said tubes below the point of their connection with the diaphragms. This effects the vibration of the beams of light directed upon the marginal portions of the film so that the exposures thereof correspond exactly in outline with the sound waves which produce them. After the negative film has been exposed, it is developed in the usual way and is then used to make a positive film in the manner already described.

As shown in Fig. 6, the positive film 14, when completed, has the photographic views on the intermediate sunken portion and phonographic record grooves 48 in its marginal portions, the latter being susceptible of reproducing sound by lateral vibrations of a reproducing needle in the ordinary way. The apparatus for reproducing the sound may be similar to the record making apparatus, except that needles are substituted for the tubes 31—32, but any approved reproducing apparatus may be employed.

While my invention is peculiarly applicable to the production of combined kinetographic and phonographic records, it is equally applicable to the reproduction of sound records only, in which case the films would be of appropriate dimensions and the apparatus employed would also be suitably modified.

That which I claim as my invention, and desire to secure by Letters Patent, is,—

1. The method of making sound records, which consists in forming a negative wave line corresponding with sound waves, by photography, making a positive from such negative on a separate film capable of being hardened by the action of light, and removing the unexposed material.

2. The method of making sound records, which consists in forming a negative wave line corresponding with sound waves, by photography, making a positive from such negative on a separate film composed of a gelatin emulsion containing bichromate of potash, and then removing the unexposed material to form a groove corresponding with the sound wave line.

3. The method of making sound records, which consists in forming a negative wave line corresponding with sound waves, by photography, making a positive from such negative on a separate film composed of an emulsion composed of gelatin, gum arabic and bichromate of potash, and then removing the unexposed material to form a groove corresponding with the sound wave line.

4. The method of making sound records, which consists in forming a negative wave line by photography, corresponding with sound waves, then forming from the negative a positive record by printing on a separate film having a marginal zone composed of material capable of being hardened by the action of light, and then removing the unexposed material.

5. The method of making sound records, which consists in kinetographically producing upon a moving film a negative wave line corresponding with sound waves, and then forming a positive record from such negative film by printing therefrom upon a separate film capable of being hardened by the action of light, and removing the unexposed material.

HAGAR BOLTON BYRON.

Witnesses:
JOHN L. JACKSON,
MINNIE A. HUNTER.

154

R. J. EMORY.

KINETOSCOPE.

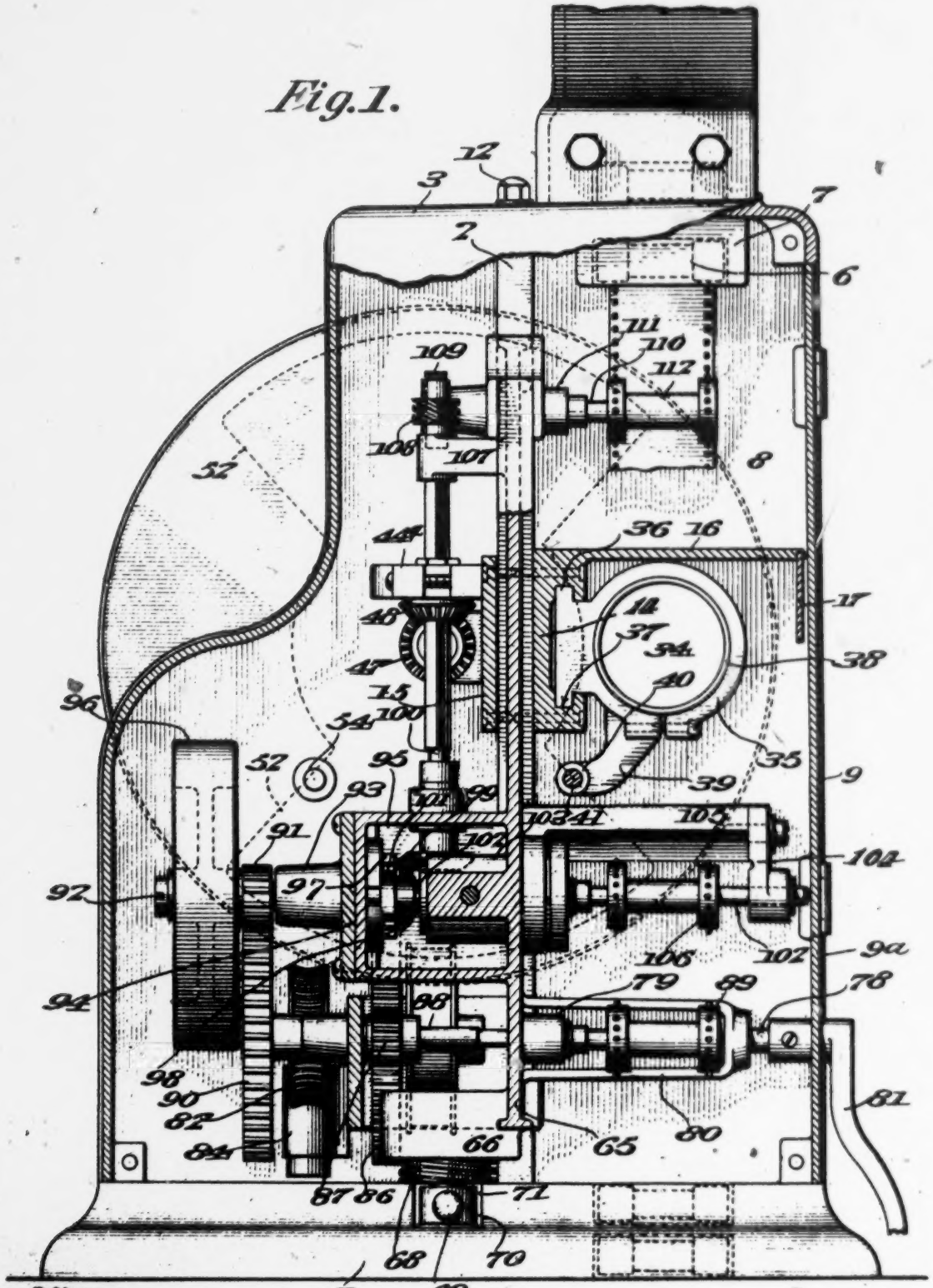
APPLICATION FILED FEB. 25, 1914.

1,292,448.

Patented Jan. 28, 1919.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
L. G. Thornton
D. F. Daniels

Inventor
Robert J. Emory.
By his Attorneys
Marrison Thornton.

156

R. J. EMORY.

KINETOSCOPE.

APPLICATION FILED FEB. 25, 1914.

1,292,448.

Patented Jan. 28, 1919.

4 SHEETS—SHEET 2.

Fig. 2.

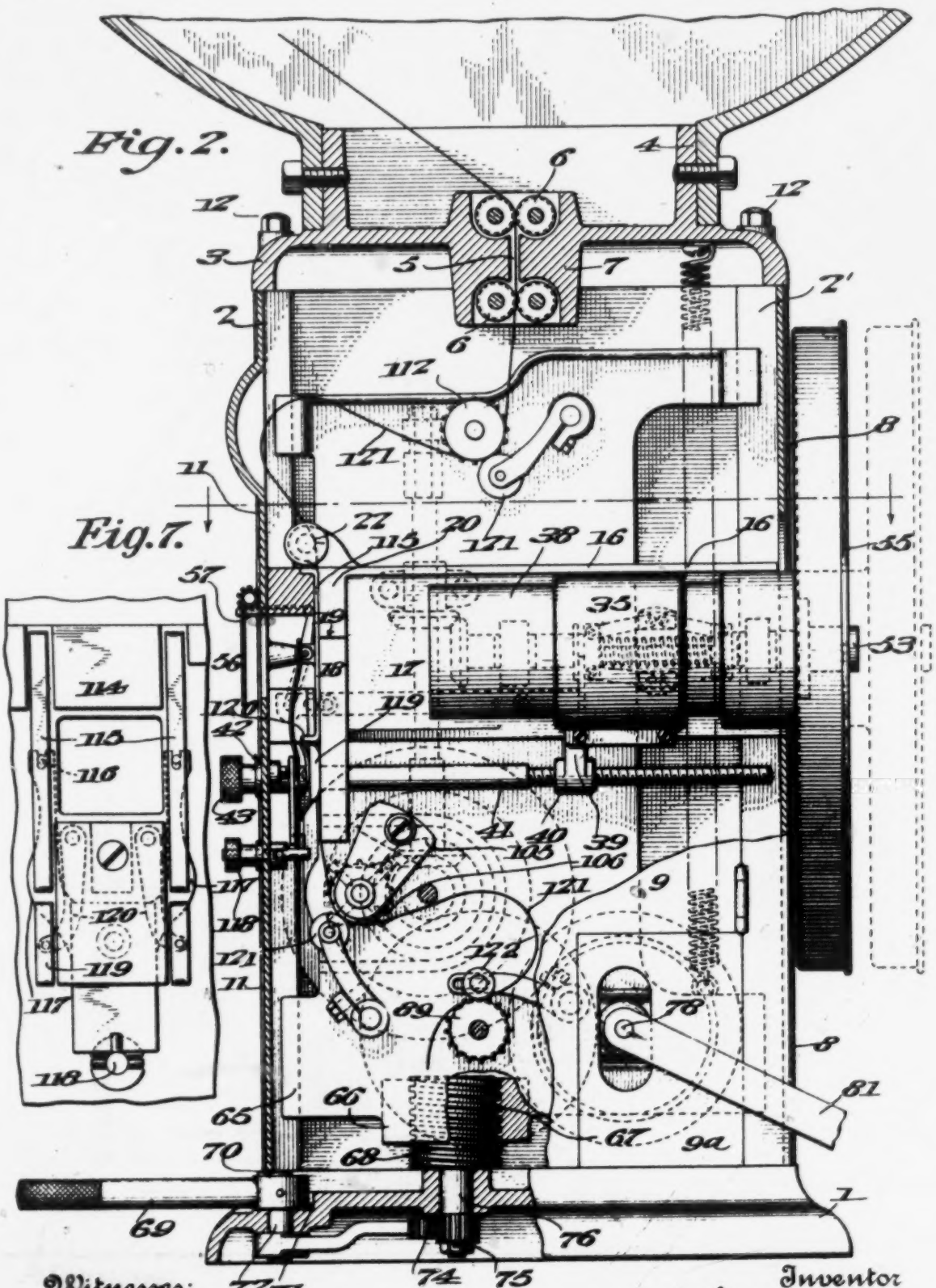


Fig. 7.

Witnesses:
S. A. Thornton
D. F. Davies

Inventor
Robert J. Emory.
By his Attorneys
Wenzen & Tinsley

158

R. J. EMORY.

KINETOSCOPE.

APPLICATION FILED FEB. 25, 1914.

1,292,448.

Patented Jan. 28, 1919.

4 SHEETS—SHEET 3.

Fig. 3.

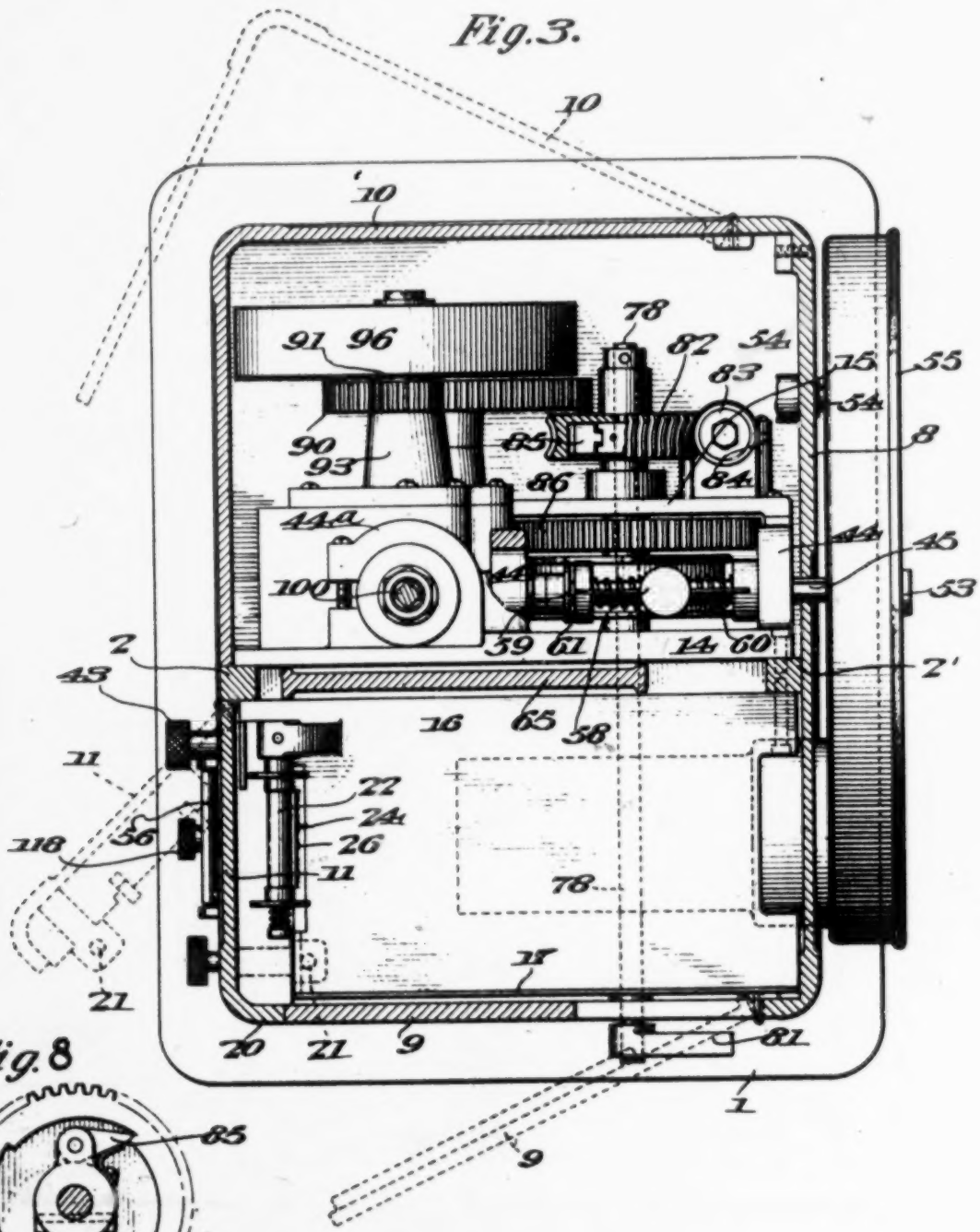
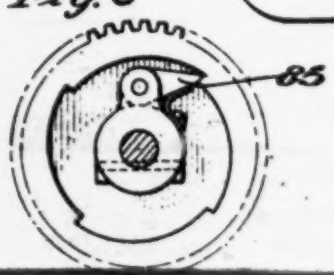


Fig. 8



KINETOSCOPE.

APPLICATION FILED FEB. 25, 1914.

1,292,448.

Patented Jan. 28, 1919.

4 SHEETS—SHEET 3.

Fig. 3.

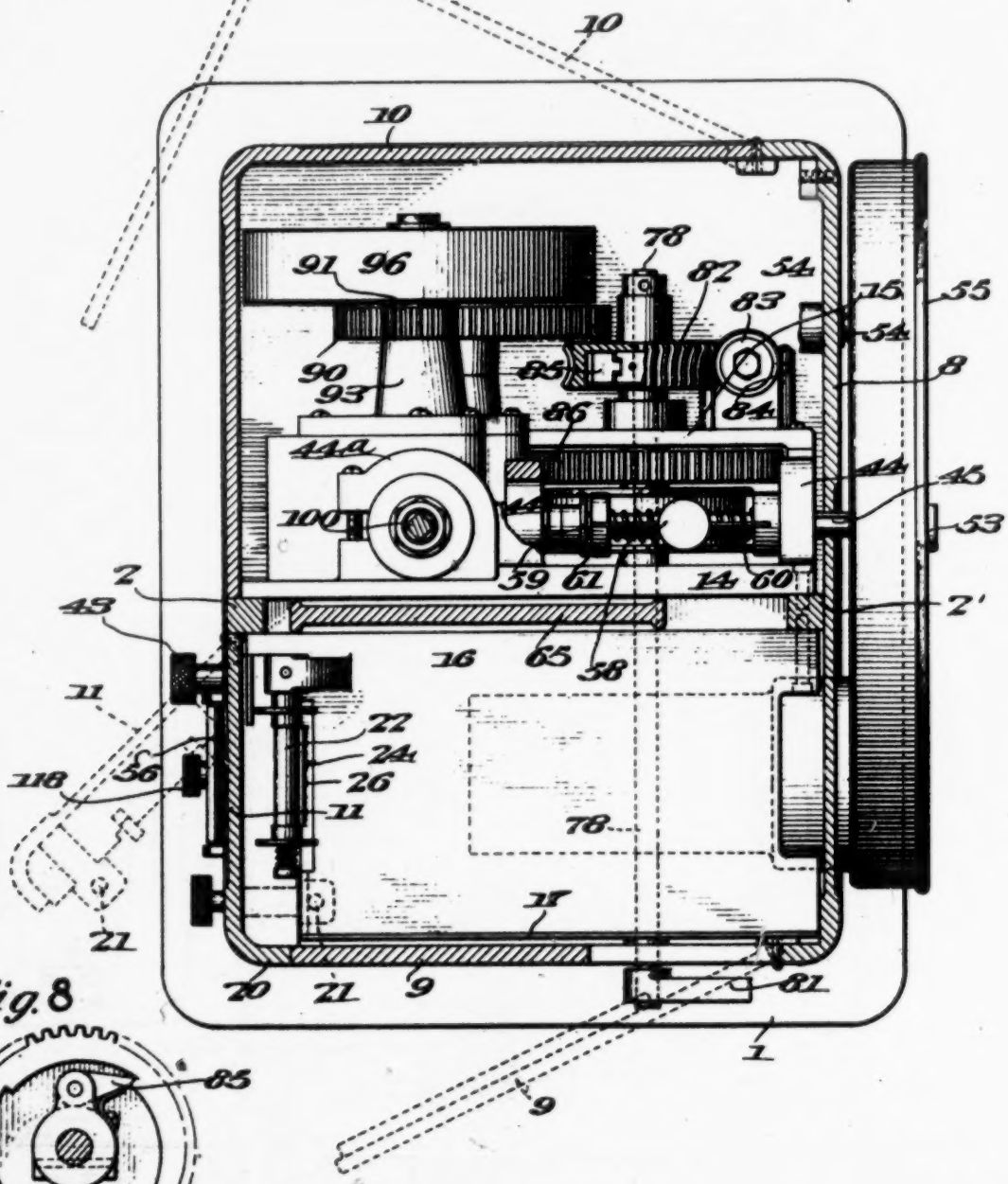
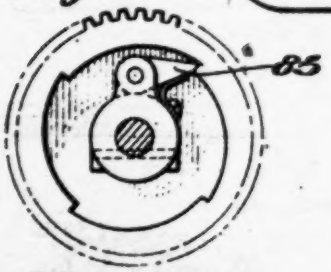


Fig. 8



Witnesses:
S. A. Thornton
D. F. Lawler

Inventor
Robert J. Emery
By his Attorneys
Munn & Co.

160

R. J. EMORY.

KINETOSCOPE.

APPLICATION FILED FEB. 25, 1914.

1,292,448.

Patented Jan. 28, 1919.

4 SHEETS—SHEET 4.

Fig. 4.

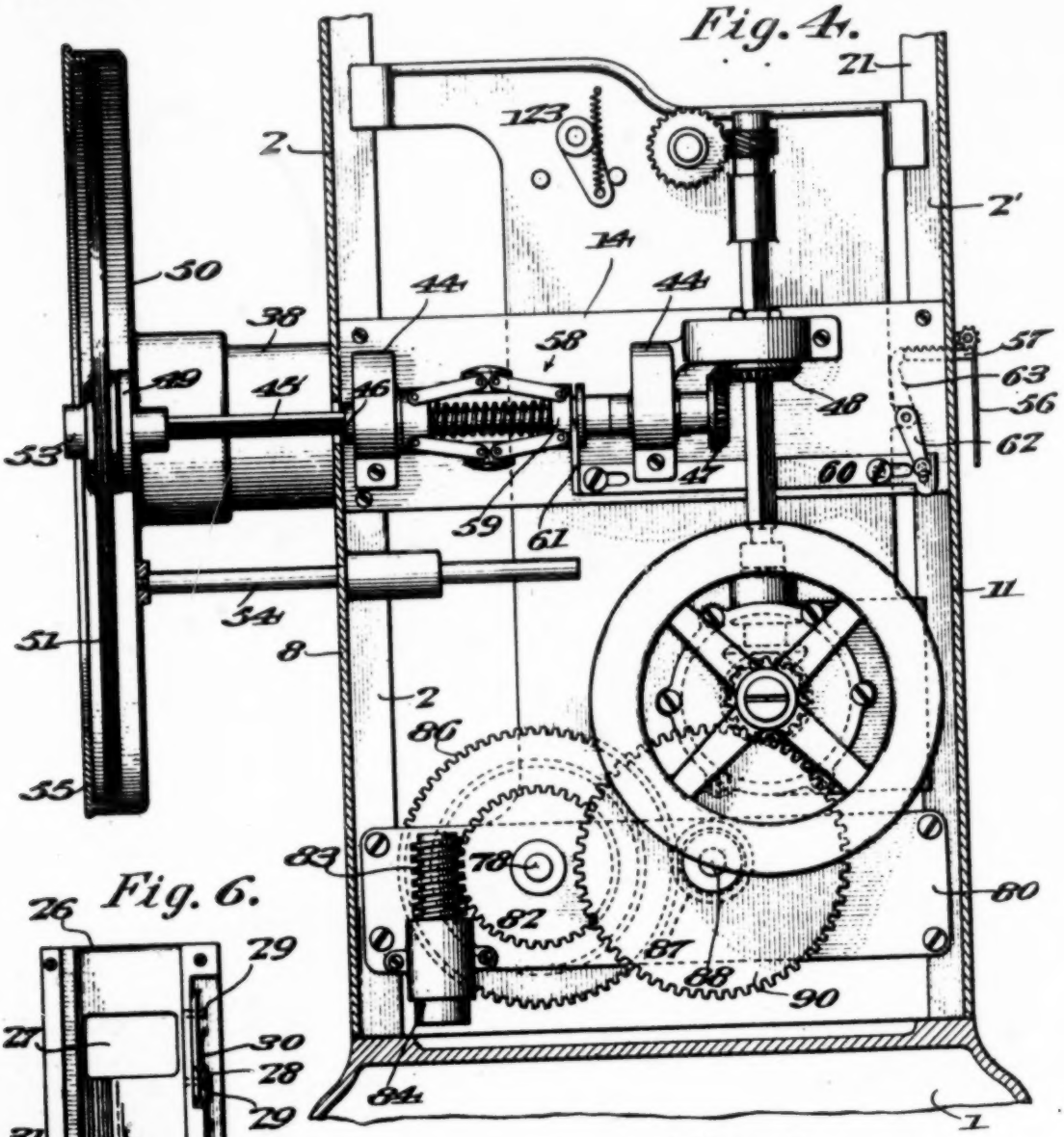


Fig. 6.

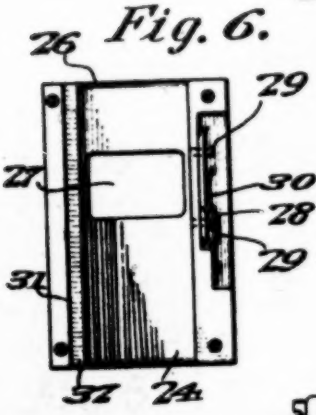
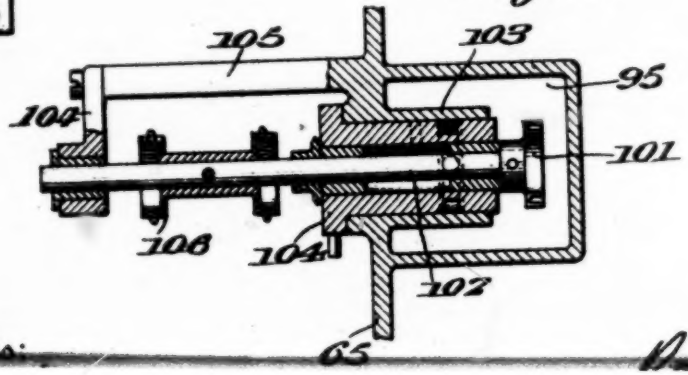


Fig. 5.



Witnesses:

Inventor

UNITED STATES PATENT OFFICE.

ROBERT J. EMORY, OF NEWARK, NEW JERSEY, ASSIGNOR TO BAIRD MOTION PICTURE MACHINE COMPANY, OF NEWARK, NEW JERSEY, A CORPORATION OF NEW JERSEY.

KINETOSCOPE.

1,292,448. Specification of Letters Patent. Patented Jan. 28, 1919.

Application filed February 25, 1914. Serial No. 821,022.

To all whom it may concern:

Be it known that I, ROBERT J. EMORY, a citizen of the United States, residing in Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Kinetoscopes, of which the following is a specification.

My invention relates to improvements in projecting mechanism for moving picture machines, and the primary object of the invention is to provide a machine in which the mechanism comprises a plurality of units, the separate parts of which are so related together and the several units are so related to each other that the machine may be readily assembled, adjustment quickly made and accurate and efficient operation maintained.

The other and more specific objects of the invention will either be obvious from the accompanying drawings or will be more fully set forth in the following description of the mechanism shown therein, in which—

Figure 1 is a rear elevation of a machine showing a preferred embodiment of my invention, a portion of the rear casing being removed and certain parts being shown in vertical section.

Fig. 2 is a side elevation of the machine with a portion of the casing shown in vertical section and with certain parts broken away to show the interior construction.

Fig. 3 is a horizontal sectional view taken on the lines 3—3 of Fig. 1.

Fig. 4 is a side elevation of the projection shutter actuating mechanism with parts of the casing in section.

Figs. 5 and 6 are detail views of the Geneva stop and the aperture plates respectively.

Fig. 7 is a view in elevation of the rear gate showing the portion opposite the aperture plate, and

Fig. 8 is a detail side elevation of the clutch mechanism showing the main shaft in section.

Referring to the particular construction shown in the drawings, the frame of the machine comprises a base 1 and two oppositely arranged upright posts or guides 2 and 2′ held in spaced relation to each erably provided with a plurality of guide rollers 6 arranged to guide the film and prevent tearing or abrasion thereof. Said rollers may be mounted in any desired manner on the cover, preferably in flanges 7 formed integral therewith. The machine is inclosed by a casing having a front wall 8 that is normally secured in fixed relation to the base and having side walls or doors 9 and 10 hinged thereto. Preferably one of said doors, as 9, comprises a section 9ª substantially at right angles to the other section so as to form a portion of the rear wall. The other portion of the rear wall comprises a separate door 11 that is hinged to one of the guides as 2. The front wall and both side walls can be removed as a unit by releasing the front wall from the top and base to which it is secured by any suitable means.

Secured to the guides are two stationary plates or brackets 14 and 15 which are arranged approximately opposite each other. The bracket 14 supports a horizontal plate 16 that is approximately parallel with the base and top and extends outwardly to engage with the adjacent securing walls or doors in their closed position so as to form a fire wall dividing the casing into upper and lower compartments. If desired, the fire wall may be integral with the bracket 14 and be provided with a depending flange 17 parallel to the side wall and with a depending end flange 18 parallel to the door 11 that may also be integral with the bracket. Said end flange is cut away as at 19 to form a lip adapted to engage with a catch or bolt 21 provided on the wall 11 and hold same in its closed position. A three part guide roller 22 is also preferably mounted on the bracket or fire wall adjacent the rear edge thereof, the parts of the roller being movable with relation to each other to permit automatic adjustment to films of varying width.

An aperture plate 24 is also supported by the bracket 14 and fits into a recess provided in the fire wall. The upper edge of the aperture plate is rounded as at 26 to permit the film to pass over the

KINETOSCOPE.

APPLICATION FILED FEB. 25, 1914.

Patented Jan. 28, 1919.

4 SHEETS—SHEET 4.

1,292,448.

Fig. 4.

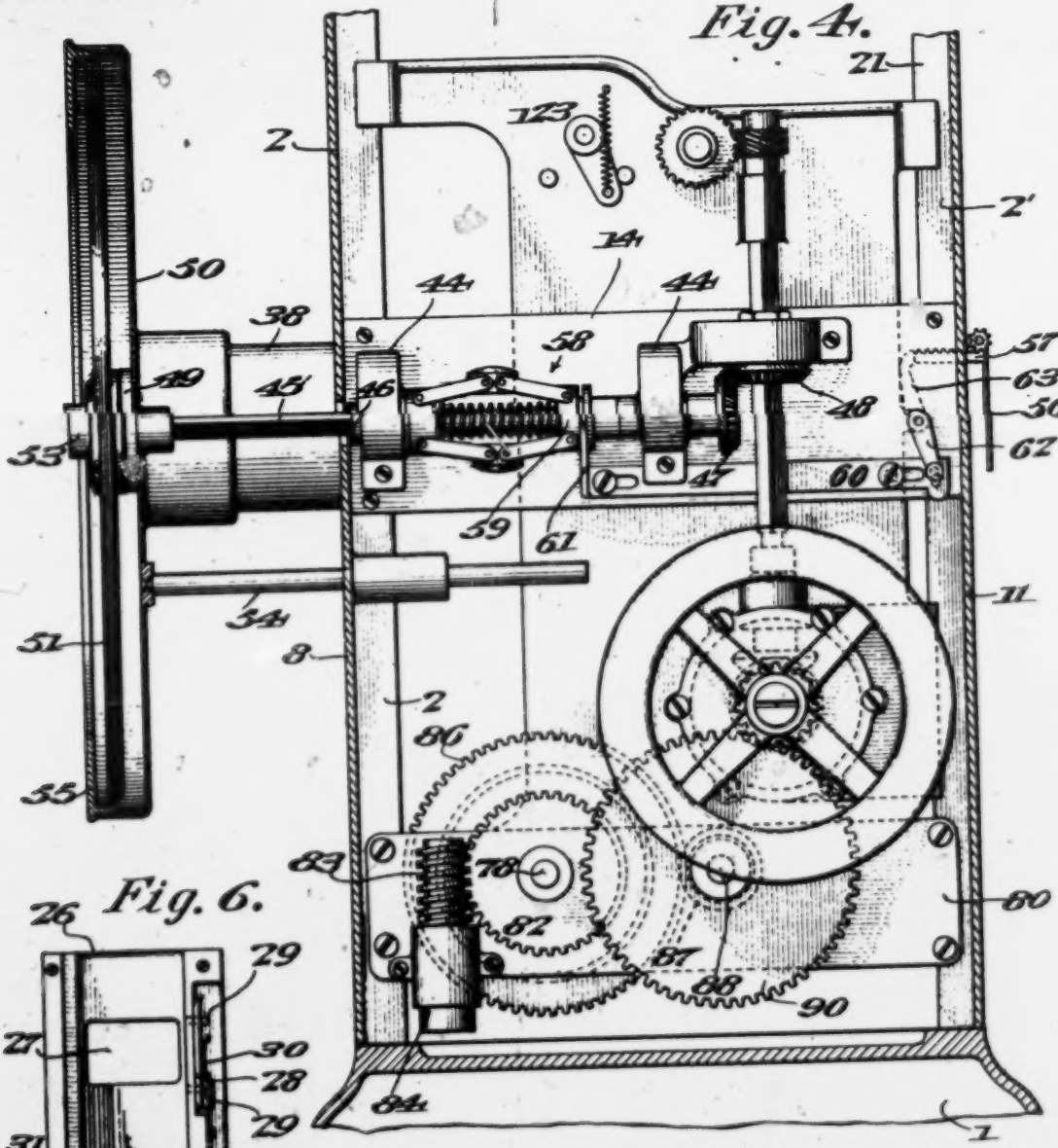


Fig. 6.

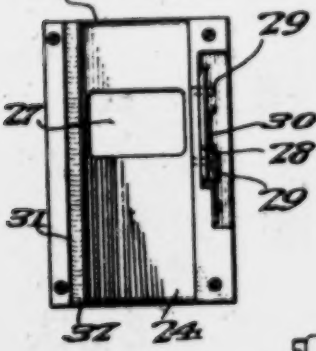
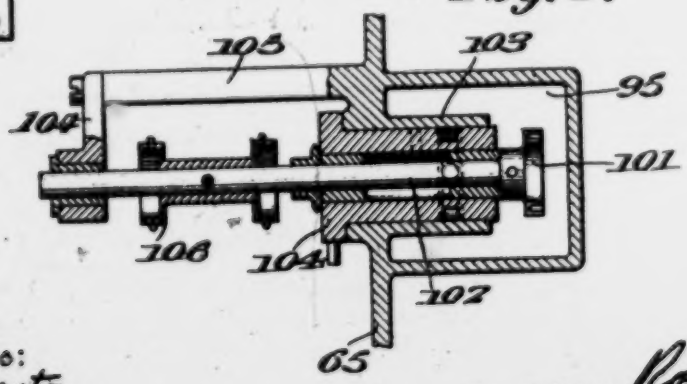


Fig. 5.



Witnesses:
L. A. Thornton
D. F. Daines

Inventor
Robert J. Emery
By his Attorneys
Wesmer & Austin

UNITED STATES PATENT OFFICE.

ROBERT J. EMORY, OF NEWARK, NEW JERSEY, ASSIGNOR TO BAIRD MOTION PICTURE MACHINE COMPANY, OF NEWARK, NEW JERSEY, A CORPORATION OF NEW JERSEY.

KINETOSCOPE.

1,292,448. Specification of Letters Patent. Patented Jan. 28, 1919.

Application filed February 25, 1914. Serial No. 821,022.

To all whom it may concern:

Be it known that I, ROBERT J. EMORY, a citizen of the United States, residing in Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Kinetoscopes, of which the following is a specification.

My invention relates to improvements in projecting mechanism for moving picture machines, and the primary object of the invention is to provide a machine in which the mechanism comprises a plurality of units, the separate parts of which are so related together and the several units are so related to each other that the machine may be readily assembled, adjustment quickly made and accurate and efficient operation maintained.

The other and more specific objects of the invention will either be obvious from the accompanying drawings or will be more fully set forth in the following description of the mechanism shown therein, in which—

Figure 1 is a rear elevation of a machine showing a preferred embodiment of my invention, a portion of the rear casing being removed and certain parts being shown in vertical section.

Fig. 2 is a side elevation of the machine with a portion of the casing shown in vertical section and with certain parts broken away to show the interior construction.

Fig. 3 is a horizontal sectional view taken on the lines 3—3 of Fig. 1.

Fig. 4 is a side elevation of the projection shutter actuating mechanism with parts of the casing in section.

Figs. 5 and 6 are detail views of the Geneva stop and the aperture plates respectively.

Fig. 7 is a view in elevation of the rear gate showing the portion opposite the aperture plate, and

Fig. 8 is a detail side elevation of the clutch mechanism showing the main shaft in section.

Referring to the particular construction shown in the drawings, the frame of the machine comprises a base 1 and two oppositely arranged upright posts or guides 2 and 2′ held in spaced relation to each other by a removable top or cover 3 preferably provided with suitable flanges 4 to support the film magazine. The top has a film slot 5 therethrough and is also preferably provided with a plurality of guide rollers 6 arranged to guide the film and prevent tearing or abrasion thereof. Said rollers may be mounted in any desired manner on the cover, preferably in flanges 7 formed integral therewith. The machine is inclosed by a casing having a front wall 8 that is normally secured in fixed relation to the base and having side walls or doors 9 and 10 hinged thereto. Preferably one of said doors, as 9, comprises a section 9ª substantially at right angles to the other section so as to form a portion of the rear wall. The other portion of the rear wall comprises a separate door 11 that is hinged to one of the guides as 2. The front wall and both side walls can be removed as a unit by releasing the front wall from the top and base to which it is secured by any suitable means.

Secured to the guides are two stationary plates or brackets 14 and 15 which are arranged approximately opposite each other. The bracket 14 supports a horizontal plate 16 that is approximately parallel with the base and top and extends outwardly to engage with the adjacent securing walls or doors in their closed position so as to form a fire wall dividing the casing into upper and lower compartments. If desired, the fire wall may be integral with the bracket 14 and be provided with a depending flange 17 parallel to the side wall and with a depending end flange 18 parallel to the door 11 that may also be integral with the bracket. Said end flange is cut away as at 19 to form a lip adapted to engage with a catch or bolt 21 provided on the wall 11 and hold same in its closed position. A three part guide roller 22 is also preferably mounted on the bracket or fire wall adjacent the rear edge thereof, the parts of the roller being movable with relation to each other to permit automatic adjustment to films of varying width.

An aperture plate 24 is also supported by the bracket 14 and fits into a recess provided in the fire wall. The upper edge of the aperture plate is rounded as at 26 to permit the film to pass over the same without abrasion. The plate is formed with an aperture 27 for the light beam and is provided at one side with a yielding projection or guide 28 movable on pins 29 nor-

mally held against displacement by any suitable means as the spring 30. Opposite said yielding flange is a stationary guide or abutment 31, said yielding flange and stationary abutment forming a recessed passage for the film and normally holding the same in its path against lateral displacement. The aperture plate, together with the yielding guide mounted thereon is secured to the bracket or fire wall in any suitable manner permitting ready adjustment or removal thereof, and has its outer face flush with the edge of the fire wall. The aperture plate is also preferably provided intermediate each edge of the aperture and the adjacent guide with a runway 32 which is raised very slightly from the face of the plate for the edge of the film.

The lens 34 is mounted in a suitable support that is carried by the bracket 14 below the fire wall. Said support comprises a clamp 35 having a flange 26 integral therewith that is mounted to move lengthwise on suitable grooves or tracks 37 provided on the bracket. A tube or sleeve 38 is mounted in the clamp and holds the lens. The clamp is also provided with a depending inwardly curved arm 39 having a threaded eye 40 to receive a threaded end of an actuating rod 41 which extends rearward through the end flange 18. The outer end of the rod also extends through a suitable aperture 42 in the door 11, in its closed position and is provided with a suitable knob 43 whereby the lens support can be actuated without opening the casing.

The plate or bracket 15 is arranged on the guides opposite the plate or bracket 14 heretofore described, and is provided with projecting spaced and parallel bearings 44 for the shutter shaft which comprises a non-circular movable section 45 that telescopes into a relatively stationary section 46. The stationary portion of the shaft is driven by a gear 47 which meshes with driving gear 48 having its hub mounted in a suitable anti-friction bearing arranged on the bracket in a plane perpendicular to the bearings 44 and holding the said gear against upward or downward displacement. The forward end of the shutter shaft is mounted in a bearing 49 on a shutter cage or casing 50 that is secured to or formed integral with the sleeve 38 which carries the lens. The projection shutter 51 is carried on the forward end of the shaft and revolves within the cage. Said shutter preferably comprises two wings or blades 52 formed integral with each other and fixed on a suitable hub 53 that will permit easy adjustment of the blades. Preferably a guide rod 54 is secured to the casing opposable cover 55 for the casing having an aperture registering with the lens may be provided if desired. The bracket 14 also carries suitable mechanism for operating the fire shutter 56 that is mounted upon the rear door 11 and is raised and lowered by a reciprocating rack 57 that also has a bearing in the door. Said operating mechanism comprises a centrifugal governor 58 mounted on the shutter shaft and connected to a movable collar 59 that actuates a sliding bar 60 through a yoke 61. The bar is connected with one arm of a lever 62 that has its other arm 63 provided with a bearing surface adapted to bear against the end of the rack 57. When the shutter shaft is at rest the arm 63 is in its retracted position, thus permitting the fire shutter to close, but when the machine is operated the governor throws the arm 63 backward, thus forcing the rack outward and automatically raising the shutter.

The film feeding and actuating mechanism is supported upon a sliding plate or carriage 65 mounted upon the guides between the stationary brackets and forming the inner wall of the upper and lower fireproof compartment established by the fire wall 16. Said plate is provided at its bottom with a head or enlargement 66 having a threaded recess or socket 67 therein to receive the threaded screw 68 which is rotatably mounted in suitable bearings in the base. The screw is actuated to raise and lower the carriage by means of an approximately horizontal handle 69 that extends from the rear of the machine and is connected to the screw through any suitable connecting means. Preferably said handle is provided with a head or enlargement 70 seating in a socket or recess 71 formed in the upper surface of the base and having a spindle 72 secured to or formed integral therewith that extends a suitable distance below the base. A segmental rack 74 is keyed to this spindle and meshes with a gear 75 mounted upon a portion 76 of the screw or worm that also projects below the base. Preferably the head or enlargement is offset with respect both to the carriage and the post and is arranged approximately in a line passing through the center of gravity of the carriage and the mechanism carried thereby.

The machine may be driven either by hand or may be driven mechanically as by a motor. The main driving shaft 78 is journaled in a support or sleeve 79 secured to or formed integral with the plate or carriage 65 and in a brace or bracket 80 secured to the plate. One end of said shaft is adapted to be driven by a crank 81 and the other

suitable means as the coupling 84 with a motor or other source of power. The worm gear 82 is coupled with the shaft by a one way clutch 85 so that the shaft will have independent rotation and the worm and gear will remain at rest when the shaft is driven manually. Said clutch also operates as a stop to limit the reverse movement of the handle. A driving gear 86 is keyed to the main shaft that meshes with a pinion 87 on a counter-shaft 88 likewise mounted in the carriage and in the bracket. Said shaft carries a lower feed sprocket 89 at one end and the gear 90 on the opposite end which meshes with a pinion 91 on a shaft 92 that is mounted in a hub 93 preferably formed integral with the cover 94 of an oil-tight chamber 95. The outer end of said shaft is provided with a flywheel 96 and the inner end carries the pinwheel 97 of the Geneva stop and a gear 98 meshing with a gear 99 keyed to a vertical driving shaft 100. The pinwheel meshes with a starwheel 101 of the usual construction that is secured to the inner end of a spindle 102 having a bearing in an adjustable sleeve 103 that is eccentrically mounted in the carriage 65. The free end of said shaft is supported in an outboard bearing 104 adjustably supported from an arm 105 secured to or formed integral with the carriage. The intermittent sprocket 106 is mounted on said shaft intermediate said bearing and the carriage.

The vertical shaft 100 passes through the top of the oil chamber 95 and the hub of the gear 48 which drives the shutter shaft. The central portion of said shaft engaging the hub is non-circular in section, permitting vertical movement of the shaft independent of the hub which is held against such movement by its bearings 44^a. The upper end of the shaft is mounted in a bearing 107 secured to the carriage and is provided adjacent said bearing with a gear 108 that meshes with a gear 109 upon one end of a shaft 110 mounted in bearings 111 on the plate. The upper feed sprocket 112 is secured to said shaft and is rotated thereby.

The rear door 11 is provided with a fixed plate 114 opposite the aperture plate and spaced slightly therefrom when the door is in its closed position to form a restricted passage for the film. Said plate is provided with a pair of shoes 115 that have a tilting or rocking movement as well as a to and fro or bodily movement opposite the runways 32. Said shoes are pivoted on sliding rods 116 that are secured to and adjusted by spring arms 117 controlled by any suitable means as the adjusting screw 118 on

The film 121 passes from the magazine (not shown) between the guide rollers 6 into the upper compartment and under the food sprocket 112 which is driven at a constant speed. The film is then drawn over the aperture plate by the intermittent sprocket 106. From this point it passes to the lower feed or take off sprocket 89 and then through any suitable opening provided in the base into a receiving magazine (not shown) of any well known or preferred construction. The film is held in contact with the intermittent sprocket and with the lower feed sprocket by means of suitable guide rollers 121 and 122 respectively, which are yieldingly held into engagement with the sprockets by any suitable means. The roller 121 is mounted so as to engage normally with the lower part of the intermittent sprocket and the roller 122 is arranged to engage the upper part of the lower feed sprocket, and consequently, the film passes above the roller 122 as well as below the same, thus forming an excess of film sufficient to prevent tearing thereof or unnecessary tension thereon.

By means of this construction the several parts of the machine are arranged in a plurality of units which are so assembled that they can readily be removed without disturbing the other parts of the machine. This arrangement also permits easy adjustment of the several parts and units with respect to each other. The machine can be operated at very high speed and is extremely steady in its operation so that practically no flicker is observable in the projected picture. The film is yieldingly but firmly held with respect to the aperture during intervals of rest and the movement of the film feeding mechanism is positively timed with the shutter so that "phantoms" and overlapping shadows are prevented.

Although I have described various features of the machine such as the fire shutter and the actuating mechanism therefor, the projection shutter and its mechanism, and the adjustment of the intermittent sprocket, these several features are set forth more in detail in my co-pending applications and no claims therefore are embodied in this application. It will be understood also that while I have shown and described, and have pointed out in the claims certain novel features of construction, arrangement and operation of one form of mechanism embodying my invention, it will be obvious to those skilled in the art that various omissions substitutions and changes in the forms and details of the machine and its operation may be

said yielding flange is a stationary guide or abutment 31, said yielding flange and stationary abutment forming a recessed passage for the film and normally holding the same in its path against lateral displacement. The aperture plate, together with the yielding guide mounted thereon is secured to the bracket or fire wall in any suitable manner permitting ready adjustment or removal thereof, and has its outer face flush with the edge of the fire wall. The aperture plate is also preferably provided intermediate each edge of the aperture and the adjacent guide with a runway 32 which is raised very slightly from the face of the plate for the edge of the film.

The lens 34 is mounted in a suitable support that is carried by the bracket 14 below the fire wall. Said support comprises a clamp 35 having a flange 26 integral therewith that is mounted to move lengthwise on suitable grooves or tracks 37 provided on the bracket. A tube or sleeve 38 is mounted in the clamp and holds the lens. The clamp is also provided with a depending inwardly curved arm 39 having a threaded eye 40 to receive a threaded end of an actuating rod 41 which extends rearward through the end flange 18. The outer end of the rod also extends through a suitable aperture 42 in the door 11, in its closed position and is provided with a suitable knob 43 whereby the lens support can be actuated without opening the casing.

The plate or bracket 15 is arranged on the guides opposite the plate or bracket 14 heretofore described, and is provided with projecting spaced and parallel bearings 44 for the shutter shaft which comprises a non-circular movable section 45 that telescopes into a relatively stationary section 46. The stationary portion of the shaft is driven by a gear 47 which meshes with driving gear 48 having its hub mounted in a suitable anti-friction bearing arranged on the bracket in a plane perpendicular to the bearings 44 and holding the said gear against upward or downward displacement. The forward end of the shutter shaft is mounted in a bearing 49 on a shutter cage or casing 50 that is secured to or formed integral with the sleeve 38 which carries the lens. The projection shutter 51 is carried on the forward end of the shaft and revolves within the cage. Said shutter preferably comprises two wings or blades 52 formed integral with each other and fixed on a suitable hub 53 that will permit easy adjustment of the blades. Preferably a guide rod 54 is secured to the casing opposite the sleeve 38 and moves in a bearing provided in the front wall 8 which serves to steady and support the cage. A removvided if desired. The bracket 14 also carries suitable mechanism for operating the fire shutter 56 that is mounted upon the rear door 11 and is raised and lowered by a reciprocating rack 57 that also has a bearing in the door. Said operating mechanism comprises a centrifugal governor 58 mounted on the shutter shaft and connected to a movable collar 59 that actuates a sliding bar 60 through a yoke 61. The bar is connected with one arm of a lever 62 that has its other arm 63 provided with a bearing surface adapted to bear against the end of the rack 57. When the shutter shaft is at rest the arm 63 is in its retracted position, thus permitting the fire shutter to close, but when the machine is operated the governor throws the arm 63 backward, thus forcing the rack outward and automatically raising the shutter.

The film feeding and actuating mechanism is supported upon a sliding plate or carriage 65 mounted upon the guides between the stationary brackets and forming the inner wall of the upper and lower fireproof compartment established by the fire wall 16. Said plate is provided at its bottom with a head or enlargement 66 having a threaded recess or socket 67 therein to receive the threaded screw 68 which is rotatably mounted in suitable bearings in the base. The screw is actuated to raise and lower the carriage by means of an approximately horizontal handle 69 that extends from the rear of the machine and is connected to the screw through any suitable connecting means. Preferably said handle is provided with a head or enlargement 70 seating in a socket or recess 71 formed in the upper surface of the base and having a spindle 72 secured to or formed integral therewith that extends a suitable distance below the base. A segmental rack 74 is keyed to this spindle and meshes with a gear 75 mounted upon a portion 76 of the screw or worm that also projects below the base. Preferably the head or enlargement is offset with respect both to the carriage and the post and is arranged approximately in a line passing through the center of gravity of the carriage and the mechanism carried thereby.

The machine may be driven either by hand or may be driven mechanically as by a motor. The main driving shaft 78 is journaled in a support or sleeve 79 secured to or formed integral with the plate or carriage 65 and in a brace or bracket 80 secured to the plate. One end of said shaft is adapted to be driven by a crank 81 and the other end is provided with a gear 82 meshing with the worm 83 rotatably supported on the carriage and adapted to be connected by any

suitable means as the coupling 84 with a motor or other source of power. The worm gear 82 is coupled with the shaft by a one way clutch 85 so that the shaft will have independent rotation and the worm and gear will remain at rest when the shaft is driven manually. Said clutch also operates as a stop to limit the reverse movement of the handle. A driving gear 86 is keyed to the main shaft that meshes with a pinion 87 on a counter-shaft 88 likewise mounted in the carriage and in the bracket. Said shaft carries a lower feed sprocket 89 at one end and the gear 90 on the opposite end which meshes with a pinion 91 on a shaft 92 that is mounted in a hub 93 preferably formed integral with the cover 94 of an oil-tight chamber 95. The outer end of said shaft is provided with a flywheel 96 and the inner end carries the pinwheel 97 of the Geneva stop and a gear 98 meshing with a gear 99 keyed to a vertical driving shaft 100. The pinwheel meshes with a starwheel 101 of the usual construction that is secured to the inner end of a spindle 102 having a bearing in an adjustable sleeve 103 that is eccentrically mounted in the carriage 65. The free end of said shaft is supported in an outboard bearing 104 adjustably supported from an arm 105 secured to or formed integral with the carriage. The intermittent sprocket 106 is mounted on said shaft intermediate said bearing and the carriage.

The vertical shaft 100 passes through the top of the oil chamber 95 and the hub of the gear 48 which drives the shutter shaft. The central portion of said shaft engaging the hub is non-circular in section, permitting vertical movement of the shaft independent of the hub which is held against such movement by its bearings 44^a. The upper end of the shaft is mounted in a bearing 107 secured to the carriage and is provided adjacent said bearing with a gear 108 that meshes with a gear 109 upon one end of a shaft 110 mounted in bearings 111 on the plate. The upper feed sprocket 112 is secured to said shaft and is rotated thereby.

The rear door 11 is provided with a fixed plate 114 opposite the aperture plate and spaced slightly therefrom when the door is in its closed position to form a restricted passage for the film. Said plate is provided with a pair of shoes 115 that have a tilting or rocking movement as well as a to and fro or bodily movement opposite the runways 32. Said shoes are pivoted on sliding rods 116 that are secured to and adjusted by spring arms 117 controlled by any suitable means as the adjusting screw 118 on the door. If desired, an additional pair of shoes 119 may be provided in line with the shoes 115 that are normally pressed outward by a spring 120 which permits a to and fro bodily movement without any tilting.

The film 121 passes from the magazine (not shown) between the guide rollers 6 into the upper compartment and under the food sprocket 112 which is driven at a constant speed. The film is then drawn over the aperture plate by the intermittent sprocket 106. From this point it passes to the lower feed or take off sprocket 89 and then through any suitable opening provided in the base into a receiving magazine (not shown) of any well known or preferred construction. The film is held in contact with the intermittent sprocket and with the lower feed sprocket by means of suitable guide rollers 121 and 122 respectively, which are yieldingly held into engagement with the sprockets by any suitable means. The roller 121 is mounted so as to engage normally with the lower part of the intermittent sprocket and the roller 122 is arranged to engage the upper part of the lower feed sprocket, and consequently, the film passes above the roller 122 as well as below the same, thus forming an excess of film sufficient to prevent tearing thereof or unnecessary tension thereon.

By means of this construction the several parts of the machine are arranged in a plurality of units which are so assembled that they can readily be removed without disturbing the other parts of the machine. This arrangement also permits easy adjustment of the several parts and units with respect to each other. The machine can be operated at very high speed and is extremely steady in its operation so that practically no flicker is observable in the projected picture. The film is yieldingly but firmly held with respect to the aperture during intervals of rest and the movement of the film feeding mechanism is positively timed with the shutter so that "phantoms" and overlapping shadows are prevented.

Although I have described various features of the machine such as the fire shutter and the actuating mechanism therefor, the projection shutter and its mechanism, and the adjustment of the intermittent sprocket, these several features are set forth more in detail in my co-pending applications and no claims therefore are embodied in this application. It will be understood also that while I have shown and described, and have pointed out in the claims certain novel features of construction, arrangement and operation of one form of mechanism embodying my invention, it will be obvious to those skilled in the art that various omissions substitutions and changes in the forms and details of the machine and its operation may be made without departing from the spirit of my invention.

I claim as my invention:—

1. In a kinetoscope, a pair of spaced guides, a movable plate disposed therebe-

tween, means for adjusting said plate, driving mechanism carried by the plate, a pair of members supported in fixed position from said guides on opposite sides of said plate, a shutter actuating mechanism carried by one of said members, and projecting mechanism carried by the other member and operatively correlated to the shutter actuating mechanism.

2. In a kinetoscope, a pair of guiding posts, a movable plate disposed therebetween, means for adjusting said plate, a pair of members supported in fixed position from said posts on opposite sides of said plate, a shutter actuating mechanism carried by one of said members, an objective carried by the other member, a film actuating mechanism carried by said movable plate and designed to move the film in operative relation to said objective, and a driving connection between said mechanism and said shutter actuating mechanism.

3. In a kinetoscope, a pair of guiding posts, a movable carrying plate disposed therebetween, a pair of members supported in fixed position from said posts on opposite sides of said plate, a shutter actuating mechanism carried by one of said members, an objective carried by the other member, a film actuating mechanism carried by said movable plate and a driving connection between said mechanism and said shutter actuating mechanism and anti-friction bearings carried by said member for mounting said shutter actuating mechanism.

4. In a kinetoscope, the combination with a frame including guides, a carriage having film actuating mechanisms and driving means thereon movable on the guides, a pair of relatively fixed spacing plates on the guides intermediate their ends, said plates having the carriage between the same, a lens mounted in one of said plates and a shutter driving mechanism on the other plate, the carriage with its actuating and driving means being removable as a unit from the guides when said plates are detached therefrom.

5. In a kinetoscope, the combination with a supporting frame, of a projection shutter actuating mechanism, fire shutter actuating mechanism and an aperture plate fixedly mounted on the frame in operative relation to each other and a film actuating mechanism including a feed sprocket, a take-up sprocket and an intermittent sprocket, slidably mounted on a carriage adjustable relative to said aperture plate and a unitary actuating means for said shutter and film-actuating mechanisms.

This specification signed and witnessed this 14th day of February, A. D., 1914.

ROBERT J. EMORY.

Signed in the presence of—

JOHN W. MEMMOTT,

G. DEC. RUTH.

Mar. 20, 1923. 1,449,327

E. JAYCOX ET AL

DRIVING MECHANISM

Filed June 4, 1920

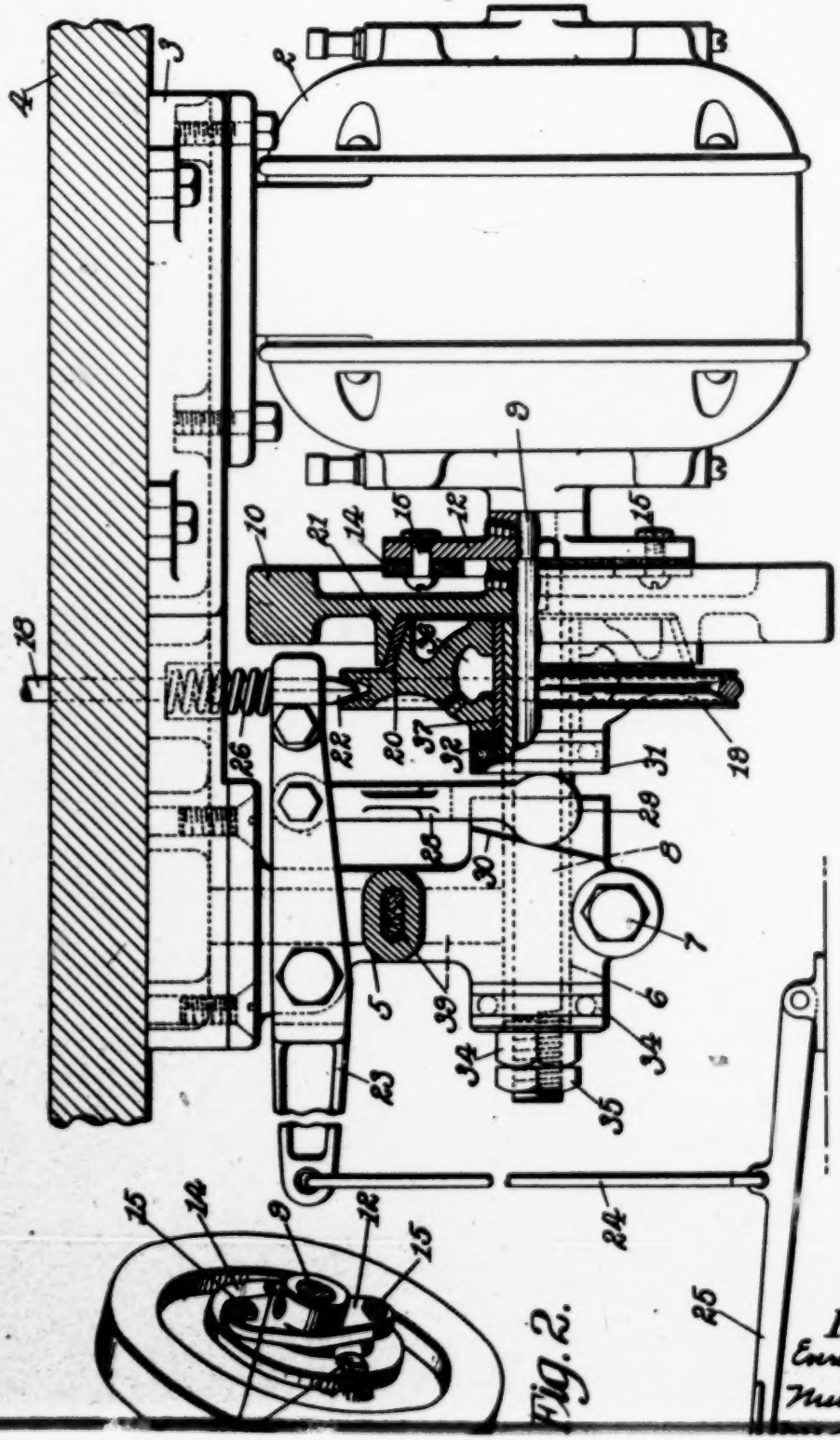


Fig. 1.

Fig. 2.

Inventors
Everett Jaycox
and
Melvin Olds.

Patented Mar. 20, 1923. 1,449,327

UNITED STATES PATENT OFFICE.

EVERETT JAYCOX, OF JOHNSON CITY, AND MELVIN OLDS, OF BINGHAMTON, NEW YORK; SAID OLDS ASSIGNOR TO SAID JAYCOX.

DRIVING MECHANISM.

Application filed June 4, 1920. Serial No. 386,449.

To all whom it may concern:

Be it known that we, EVERETT JAYCOX and MELVIN OLDS, citizens of the United States, residing at Johnson City and Binghamton, in the county of Broome and State of New York, have invented a new and useful Improvement in Driving Mechanisms, of which the following description, in connection with the accompanying drawings, is a specification, like reference characters on the drawings indicating like parts in the several figures.

This invention relates to driving mechanisms or starting and stopping mechanisms for machines and will be herein disclosed as embodied in a mechanism designed especially for driving leather stitching or sewing machines, although it will be understood that the same mechanism can be used to advantage in driving other types of machines. In driving an outsole stitcher, welter, or similar machine which operates on heavy leather, an unusual load is placed on the driving mechanism when the machine is started into operation. A motor usually is selected for the driving of such a machine that is large enough to carry the normal load and give a reasonable overload capacity and it is undesirable from the standpoint of economy to use a larger motor. The starting resistance of such a machine, however, is frequently sufficient to slow down the motor to an undesirable degree, or even to stop it.

It is an important object of the present invention to devise a mechanism that will effectually overcome this difficulty without increasing the size or power of the motor required to drive the machine. The invention also is directed to the provision of a mechanism of this character which can be economically manufactured, which will be reliable in operation, will require relatively little care or attention, and will not be subject to rapid wear or deterioration.

The nature of the invention will be readily understood from the following description when read in connection with the accompanying drawings, and the novel features will be particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is a side elevation of a driving mechanism embodying the invention in the form at present preferred; and

Fig. 2 is a perspective view illustrating the connection between the motor and the fly wheel.

The construction shown comprises an electric motor 2 mounted in an inverted position on a base 3 which is secured to a support 4. Also mounted on this base, and depending therefrom, is a bracket 5 having a split head at its lower end in which a bearing bushing 6 is mounted, the bushing being clamped in the bracket by a bolt 7. A shaft 8 is rotatably mounted in this bushing in a co-axial relationship to the driving shaft 9 of the motor 2. A fly wheel 10 is secured fast on the end of the shaft 8 adjacent to the motor and is directly connected to the motor shaft by a flexible coupling. This coupling comprises a collar 12 secured to the shaft 9 and having oppositely extended arms, as best shown in Fig. 2, and a flexible ring 14 secured to these arms by bolts 15—15. At points spaced angularly by 90° from the bolts 15—15, the ring 14 is secured to the fly wheel 10 by bolts 16—16. The member 14 preferably consists of a ring of leather or heavy woven fabric such as that used for brake linings and clutch facings.

By this arrangement the fly wheel 10 is constantly driven so long as the motor 2 is in operation.

The machine to be driven is connected by a belt 18 to a grooved pulley 19 that rotates freely on the stationary bushing 6. This pulley is provided with a cone clutch face covered with a suitable lining or facing material 20 and cooperates with a similar face 21 on the fly wheel 10 to form a clutch by means of which a driving connection is established between the pulley and the fly wheel. Normally the pulley is out of driving engagement with the fly wheel and is held at rest by a fibre brake piece 22 mounted on the forward end of a lever 23 which is fulcrumed on the bracket 5 and is connected at its rearward end by means of a rod 24 to a foot treadle 25. A coiled spring 26 interposed between the base 3 and the lever 23 tends to hold the brake 22 in engagement with the groove in the pulley 19

Mar. 20, 1923. 1,449,327

E. JAYCOX ET AL

DRIVING MECHANISM

Filed June 4, 1920

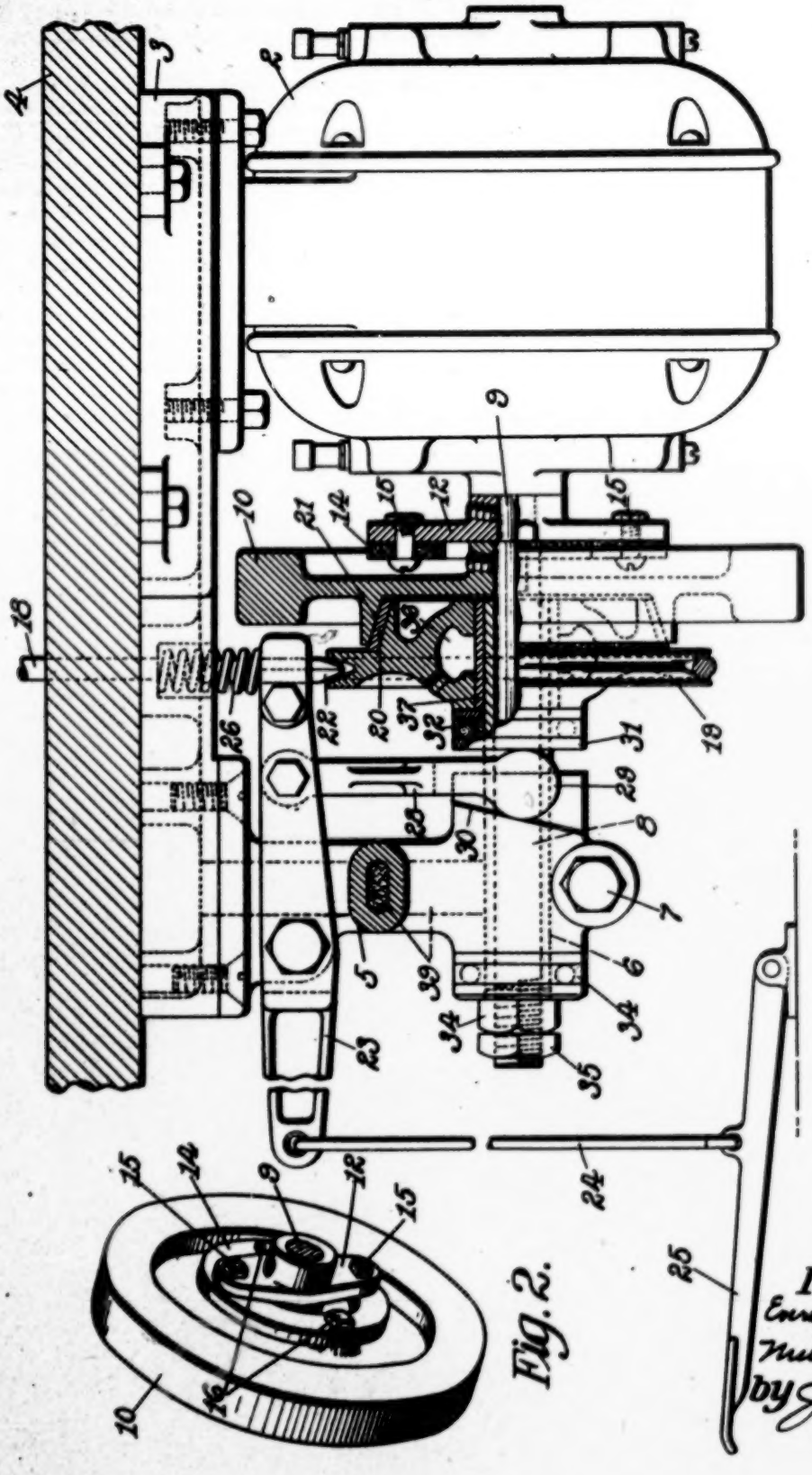


Fig. 1.

Fig. 2.

Inventors
Ernest Jaycox
and
Melvin Olds,
by J. A. McCready
their Atty.

UNITED STATES PATENT OFFICE.

EVERETT JAYCOX, OF JOHNSON CITY, AND MELVIN OLDS, OF BINGHAMTON, NEW YORK; SAID OLDS ASSIGNOR TO SAID JAYCOX.

DRIVING MECHANISM.

Application filed June 4, 1920. Serial No. 386,449.

To all whom it may concern:

Be it known that we, EVERETT JAYCOX and MELVIN OLDS, citizens of the United States, residing at Johnson City and Binghamton, in the county of Broome and State of New York, have invented a new and useful Improvement in Driving Mechanisms, of which the following description, in connection with the accompanying drawings, is a specification, like reference characters on the drawings indicating like parts in the several figures.

This invention relates to driving mechanisms or starting and stopping mechanisms for machines and will be herein disclosed as embodied in a mechanism designed especially for driving leather stitching or sewing machines, although it will be understood that the same mechanism can be used to advantage in driving other types of machines. In driving an outsole stitcher, welter, or similar machine which operates on heavy leather, an unusual load is placed on the driving mechanism when the machine is started into operation. A motor usually is selected for the driving of such a machine that is large enough to carry the normal load and give a reasonable overload capacity and it is undesirable from the standpoint of economy to use a larger motor. The starting resistance of such a machine, however, is frequently sufficient to slow down the motor to an undesirable degree, or even to stop it.

It is an important object of the present invention to devise a mechanism that will effectually overcome this difficulty without increasing the size or power of the motor required to drive the machine. The invention also is directed to the provision of a mechanism of this character which can be economically manufactured, which will be reliable in operation, will require relatively little care or attention, and will not be subject to rapid wear or deterioration.

The nature of the invention will be readily understood from the following description when read in connection with the accompanying drawings, and the novel features will be particularly pointed out in the appended claims.

Referring now to the drawings,

Figure 1 is a view partly in side elevation and partly in vertical cross section, of a mechanism embodying the invention in the form at present preferred; and

Fig. 2 is a perspective view illustrating the connection between the motor and the fly wheel.

The construction shown comprises an electric motor 2 mounted in an inverted position on a base 3 which is secured to a support 4. Also mounted on this base, and depending therefrom, is a bracket 5 having a split head at its lower end in which a bearing bushing 6 is mounted, the bushing being clamped in the bracket by a bolt 7. A shaft 8 is rotatably mounted in this bushing in a co-axial relationship to the driving shaft 9 of the motor 2. A fly wheel 10 is secured fast on the end of the shaft 8 adjacent to the motor and is directly connected to the motor shaft by a flexible coupling. This coupling comprises a collar 12 secured to the shaft 9 and having oppositely extended arms, as best shown in Fig. 2, and a flexible ring 14 secured to these arms by bolts 15—15. At points spaced angularly by 90° from the bolts 15—15, the ring 14 is secured to the fly wheel 10 by bolts 16—16. The member 14 preferably consists of a ring of leather or heavy woven fabric such as that used for brake linings and clutch facings.

By this arrangement the fly wheel 10 is constantly driven so long as the motor 2 is in operation.

The machine to be driven is connected by a belt 18 to a grooved pulley 19 that rotates freely on the stationary bushing 6. This pulley is provided with a cone clutch face covered with a suitable lining or facing material 20 and cooperates with a similar face 21 on the fly wheel 10 to form a clutch by means of which a driving connection is established between the pulley and the fly wheel. Normally the pulley is out of driving engagement with the fly wheel and is held at rest by a fibre brake piece 22 mounted on the forward end of a lever 23 which is fulcrumed on the bracket 5 and is connected at its rearward end by means of a rod 24 to a foot treadle 25. A coiled spring 26 interposed between the base 3 and the lever 23 tends to hold the brake 22 in engagement with the groove in the pulley 19.

For the purpose of moving the pulley longitudinally of its axis of rotation to bring the clutch faces 20 and 21 into driving en-

gagement, an arm 28 is pivoted at its upper end to the lever 23 and is provided with a rounded head 29 to engage an inclined face 30 formed on the bracket 5. This head also engages the collar 31 of a ball thrust bearing 32. When the treadle 25 is depressed, the right hand end, Fig. 1, of the lever 23 is raised thus lifting the brake 22 off the pulley 19 and simultaneously raising the arm 28. The rounded part 29 of this arm engaging the inclined face 30 of the bracket forces the pulley 19 toward the right, this movement being transmitted through the thrust ball bearing 32, and the clutch face on the pulley thus is forced into driving engagement with the cooperating face on the fly wheel 10. The momentum of the fly wheel due to its rotation with the motor shaft is of very material assistance in overcoming the starting resistance of the machine and thus enables the motor to pick up the load smoothly and easily, avoiding the danger of stopping, and preventing the undesirable reduction of speed which, as above described, has proved to be one of the objections to the present driving mechanisms.

It is desirable to prevent the transmission of any endwise movement to the motor shaft during the operation of the clutch and for this purpose a thrust bearing 34, preferably consisting of a ball bearing, is located between the left-hand end of the bracket 5 and the corresponding end of the shaft 8. A nut 34′ and a check nut 35 threaded on the end of the shaft bear against the outer collar of the ball bearing 34 and provide a convenient means for adjusting the shaft 8 longitudinally.

The pulley 19 preferably is of the self-lubricating type and is provided with an internal oil reservoir 36 closed adjacent to the bore of the pulley by a bushing 37, the bushing being provided with holes to admit lubricating material to the friction surface between the bushings 37 and 6. The bracket 5 also is provided with a cavity 39 to receive waste or packing that may be saturated with oil, this oil being conducted by suitable ducts to the internal bearing surface of the stationary bushing 6 where it lubricates the shaft 8.

When the treadle 25 is released the spring 26 immediately acts to force the brake 22 into engagement with the groove in the pulley 19, and the lowering of the member 29 along the cam face 30 permits the pulley to move toward the left to disengage the clutch faces 20 and 21. The latter movement of the pulley is produced partly by the clutch faces and partly by the engagement of the

It will now be understood that this invention provides a very simple and reliable construction which overcomes the starting difficulties above described that have been found to exist with prior mechanisms of this general type. It will also be seen that the mechanism is so designed that it is not liable to get out of order and will run for a long period of time without care or attention.

What is claimed as new is:

1. A driving mechanism of the character described comprising a motor having a driving shaft, a driven shaft mounted co-axially with said driving shaft, a fly wheel fast on said driven shaft, a flexible coupling connecting said fly wheel with said driving shaft, a pulley rotating about the axis of said driven shaft, said pulley and fly wheel having cooperating clutch faces and said pulley being movable longitudinally of said axis to engage or disengage said faces, means for forcing said pulley toward said fly wheel, and a thrust bearing for limiting the movement of said driven shaft toward said driving shaft.

2. A driving mechanism of the character described comprising a motor having a driving shaft, a driven shaft mounted co-axially with said driving shaft, a fly wheel fast on said driven shaft, a flexible coupling connecting said fly wheel with said driving shaft, a pulley rotating about the axis of said driven shaft, said pulley and fly wheel having cooperating clutch faces and said pulley being movable longitudinally of said axis to engage or disengage said faces, means for forcing said pulley toward said fly wheel, and a ball bearing through which said movement is transmitted to said pulley.

3. A driving mechanism of the character described comprising a motor having a driving shaft, a driven shaft mounted co-axially with said driving shaft, a fly wheel fast on said driven shaft, a flexible coupling connecting said fly wheel with said driving shaft, a stationary bushing supporting said shaft, a pulley rotatably mounted on said bushing, said pulley and fly wheel having cooperating clutch faces and said pulley being movable longitudinally of said bushing to engage or disengage said faces, a thrust bearing for limiting the movement of said driven shaft toward said driving shaft, a bracket supporting said bushing, and a manually operated member cooperating with said bracket to force said pulley toward said fly wheel.

4. A driving mechanism of the character described comprising, in combination, a motor, a fly wheel mounted to rotate with the

cone clutch member rotatable about said axis and cooperating with the cone clutch face on said fly wheel, a lever for moving said clutch member into engagement with said clutch face, a brake arranged to be operated by said lever to stop the rotation of said clutch member and pulley, and a spring acting on said lever in a direction tending to operate the brake and to permit said clutch member to disengage said clutch face.

5. A driving mechanism of the character described comprising, in combination, a motor, a fly wheel mounted to rotate with the shaft of said motor, said fly wheel having a cone clutch face thereon, a bearing bracket, a second shaft supported in said bracket coaxially with said motor shaft, a pulley mounted on said second shaft, a cone clutch member rotating with said pulley, a lever pivoted on said bracket for moving said member axially of said second shaft into engagement with said clutch face, and a brake carried by said lever and arranged to engage a part rotatable with said clutch member.

In testimony whereof we have signed our names to this specification.

EVERETT JAYCOX.
MELVIN OLDS.

gagement, an arm 28 is pivoted at its upper end to the lever 23 and is provided with a rounded head 29 to engage an inclined face 30 formed on the bracket 5. This head also engages the collar 31 of a ball thrust bearing 32. When the treadle 25 is depressed, the right hand end, Fig. 1, of the lever 23 is raised thus lifting the brake 22 off the pulley 19 and simultaneously raising the arm 28. The rounded part 29 of this arm engaging the inclined face 30 of the bracket forces the pulley 19 toward the right, this movement being transmitted through the thrust ball bearing 32, and the clutch face on the pulley thus is forced into driving engagement with the cooperating face on the fly wheel 10. The momentum of the fly wheel due to its rotation with the motor shaft is of very material assistance in overcoming the starting resistance of the machine and thus enables the motor to pick up the load smoothly and easily, avoiding the danger of stopping, and preventing the undesirable reduction of speed which, as above described, has proved to be one of the objections to the present driving mechanisms.

It is desirable to prevent the transmission of any endwise movement to the motor shaft during the operation of the clutch and for this purpose a thrust bearing 34, preferably consisting of a ball bearing, is located between the left-hand end of the bracket 5 and the corresponding end of the shaft 8. A nut 34′ and a check nut 35 threaded on the end of the shaft bear against the outer collar of the ball bearing 34 and provide a convenient means for adjusting the shaft 8 longitudinally.

The pulley 19 preferably is of the self-lubricating type and is provided with an internal oil reservoir 36 closed adjacent to the bore of the pulley by a bushing 37, the bushing being provided with holes to admit lubricating material to the friction surface between the bushings 37 and 6. The bracket 5 also is provided with a cavity 39 to receive waste or packing that may be saturated with oil, this oil being conducted by suitable ducts to the internal bearing surface of the stationary bushing 6 where it lubricates the shaft 8.

When the treadle 25 is released the spring 26 immediately acts to force the brake 22 into engagement with the groove in the pulley 19, and the lowering of the member 29 along the cam face 30 permits the pulley to move toward the left to disengage the clutch faces 20 and 21. The latter movement of the pulley is produced partly by the clutch faces and partly by the engagement of the brake member 22 with the left-hand wall of the belt receiving groove in the pulley. The brake brings the pulley to rest and the parts remain in this position until the treadle is again depressed.

It will now be understood that this invention provides a very simple and reliable construction which overcomes the starting difficulties above described that have been found to exist with prior mechanisms of this general type. It will also be seen that the mechanism is so designed that it is not liable to get out of order and will run for a long period of time without care or attention.

What is claimed as new is:

1. A driving mechanism of the character described comprising a motor having a driving shaft, a driven shaft mounted co-axially with said driving shaft, a fly wheel fast on said driven shaft, a flexible coupling connecting said fly wheel with said driving shaft, a pulley rotating about the axis of said driven shaft, said pulley and fly wheel having cooperating clutch faces and said pulley being movable longitudinally of said axis to engage or disengage said faces, means for forcing said pulley toward said fly wheel, and a thrust bearing for limiting the movement of said driven shaft toward said driving shaft.

2. A driving mechanism of the character described comprising a motor having a driving shaft, a driven shaft mounted co-axially with said driving shaft, a fly wheel fast on said driven shaft, a flexible coupling connecting said fly wheel with said driving shaft, a pulley rotating about the axis of said driven shaft, said pulley and fly wheel having cooperating clutch faces and said pulley being movable longitudinally of said axis to engage or disengage said faces, means for forcing said pulley toward said fly wheel, and a ball bearing through which said movement is transmitted to said pulley.

3. A driving mechanism of the character described comprising a motor having a driving shaft, a driven shaft mounted co-axially with said driving shaft, a fly wheel fast on said driven shaft, a flexible coupling connecting said fly wheel with said driving shaft, a stationary bushing supporting said shaft, a pulley rotatably mounted on said bushing, said pulley and fly wheel having cooperating clutch faces and said pulley being movable longitudinally of said bushing to engage or disengage said faces, a thrust bearing for limiting the movement of said driven shaft toward said driving shaft, a bracket supporting said bushing, and a manually operated member cooperating with said bracket to force said pulley toward said fly wheel.

4. A driving mechanism of the character described comprising, in combination, a motor, a fly wheel mounted to rotate with the shaft of said motor, said fly wheel having a cone clutch face thereon, a bearing bracket, a driven shaft supported in said bracket co-axially with said motor shaft, a pulley rotatable about the axis of said driven shaft, a

on said fly wheel, a lever for moving said clutch member into engagement with said clutch face, a brake arranged to be operated by said lever to stop the rotation of said clutch member and pulley, and a spring acting on said lever in a direction tending to operate the brake and to permit said clutch member to disengage said clutch face.

5. A driving mechanism of the character described comprising, in combination, a motor, a fly wheel mounted to rotate with the shaft of said motor, said fly wheel having a cone clutch face thereon, a bearing bracket, mounted on said second shaft, a cone clutch member rotating with said pulley, a lever pivoted on said bracket for moving said member axially of said second shaft into engagement with said clutch face, and a brake carried by said lever and arranged to engage a part rotatable with said clutch member.

In testimony whereof we have signed our names to this specification.

EVERETT JAYCOX.
MELVIN OLDS.

N° 19,667 A.D. 1912

(*Under International Convention.*)

Date claimed for Patent under Patents and Designs Act, 1907, being date of first Foreign Application (in Germany), 29th Apr., 1912

Date of Application (in the United Kingdom), 28th Aug., 1912

Accepted, 14th Nov., 1912

COMPLETE SPECIFICATION.

Improvements in Gramophones and other Sound Recording and Reproducing Machines.

I, Dr. Erwin Kramer, of 92, Gruefestrasse, Berlin, S., 59, in the German Empire, Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

My invention relates to gramophones and other sound recording and reproducing machines, and particularly to disc machines and has reference to a device by means of which the body which carries the talking disc or cylinder may be stopped and thereafter set in rotation again with almost the full angular velocity.

Considerable difficulties especially in disc-machines have heretofore been experienced in effecting this since the turntable carrying the disc or record is of a relatively large diameter and thus forms a heavy rotating mass which can only be stopped and set in motion slowly.

In using the talking machine as a dictating apparatus however, it is necessary that when the dictator or the receiver breaks off the carrier of the record or blank shall be set in motion again suddenly.

By my invention this is effected in the following simple way:

The member which carries the disc or the cylinder is connected with the driving mechanism by a coupling which, when in engagement carries with it the turntable or the like, but when it is disengaged brakes the same.

The driving mechanism is at the same time furnished with a powerful fly-wheel so proportioned to the turntable or the like that when the driving mechanism is thrown into engagement with the stationary turntable no objectionable delay occurs; it is thus possible, when my invention is made use of, to employ as driving mechanism for the turntable or the like any kind of driving mechanism, such as clockwork, electro-motors or the like.

Figures 1 and 2 shew, as an example, a method of application to a disc talking machine.

Figure 1 shews a vertical section through the new arrangement; and

Figure 2 an elevation of the mechanism for operating it.

To the driving spindle 1, which is set in motion in any desired way there is firmly keyed a fly-wheel 2. Above the upper part of the spindle 1 extends a

sleeve 3, which turns loosely upon it. It abuts on one side against the fly-wheel 2 and on the other side is secured in its position upon the spindle 1 by a nut 4.

Firmly connected with the sleeve 3 is the turntable 5. The brake disc 6 is passed over the casing 3 and is movable in a vertical direction. The sleeve 3 is so connected with the disc 6 by a pin 7 or the like, which can be moved up and down in a groove 8 formed in the sleeve 3, that it can only rotate at the same time as the disc 6.

Between a projecting shoulder on the sleeve 3 and the disc 6 there is arranged a pressure spring 9 which tends to force the disc 6 downwards. A ring of leather, indiarubber or the like 10, arranged on the outer edge of the latter is then applied against the fly-wheel 2. As the result of the friction set up between the ring 10 and the fly-wheel 2, the disc 6 and with it the sleeve 3 and the turntable 5 are connected with the fly-wheel 2 and through this again with the driving mechanism.

The disc 6, further, has upon its upper surface a second ring of leather, rubber or the like 11, corresponding to the ring 10. If the disc 6 be raised, the ring 10 first rises from the fly-wheel 2 directly after which the ring 11 is applied against a corresponding ring 13 placed above it, and which ring 13 is carried by a plate 14, which is firmly fixed to the wooden casing 15 or is otherwise rendered stationary.

By this means the disc 6 is coupled to the fixed plate 14, whereby the turntable 5 is braked. It is consequently brought to rest almost suddenly in the desired way. If now the disc 6 be lowered again it moves out of contact with the plate 14 and immediately thereafter couples the turntable 5 with the driving mechanism and the fly-wheel 2. The turntable then begins to rotate again and acquires its full velocity almost at once. This obviates the liability of spoken or rendered words being indistinct.

Figure 2 shews how the raising and lowering of the disc 6 is effected. It is provided with a projecting flange 16 beneath which there engages a suitably coupled forked lever 17 turning on a pivot 18 on to the plate 14 so that the disc 6 can be raised by merely pressing upon the arm 19 of the lever.

In order to avoid the necessity for constantly pressing upon the lever 19 when the turntable 5 is brought to rest a push-rod 21 sliding in a block 20 or the like, is provided the said push rod having an inclined surface 22 which bears upon the lever 19.

If the push-rod 21 be drawn to the left it sets the lever 19 free and the turntable is thrown into engagement with the driving mechanism; if the push-rod 21 on the other hand be pushed to the right its inclined part 22 depresses the lever 19, whereupon the lever 17 rises, presses on the flange 16 and lifts the disc 6 which thereupon arrests the motion of the turntable 5.

The inclination of the surface 22 is so chosen that the rod when pressure is withdrawn from it will remain in the position to which it has been moved to depress the lever 19.

Instead of the push-rod 21 any other suitable appliance may, of course, be used, for example, an eccentric or the like.

It is essential for the apparatus that the mass of the disc 2 relatively to the portions to be slowed down or quickened, shall be so chosen that the arrests and accelerations of the carrier of the record or blank are so short as to give rise to no disturbances in the recording or reproduction.

Any kind of coupling may, of course, be used for engaging the turntable 5 with, and disengaging it from, the driving mechanism or fixed body; the employment of a friction coupling, however, especially if it be covered with rubber or leather, as herein described, is specially favourable for producing a noiseless and gentle stopping and starting.

The construction herein described and illustrated has further the important advantage that no loss of power in working is involved by the coupling. If,

for example, the coupling is thrown in, the lever 17 can be pressed downward so that it does not come into contact with the flange 16; this is, possible because the coupling is not due to force introduced from without but to the spring 9 placed between the disc 6 and the sleeve 3. The expenditure of power in my arrangement is thus no greater in operation than in the forms of apparatus hitherto in use.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A device for coupling and uncoupling the member carrying the record disc or cylinder of a sound recording and reproducing machine and especially the turntable in a disc machine, from the driving mechanism, wherein the turntable is coupled by a coupling of any desired kind with a fixed body or with the driving mechanism which is provided with a fly-wheel, substantially as hereinbefore described.

2. A device of the kind claimed in Claim 1, wherein for throwing the turntable in and out of engagement a coupling is used which is engaged by a spring which partakes of the rotation of the mechanism and wherein a force transmitted from without is used only for disengaging the coupling substantially as hereinbefore described.

3. A device of the kind claimed in Claim 1 or 2, wherein a sleeve carrying the turntable is loosely and rotatably passed over the top of the driving spindle and carries a coupling movable vertically and partaking of its rotation and pressed by a spring downwards against a fly-wheel fixed to the driving spindle or a corresponding disc, and is adapted by means of an outwardly extending lever or the like, to be raised from the fly-wheel and pressed against a fixed plate, substantially as hereinbefore described.

4. A device of the kind claimed in Claim 1, 2 or 3 wherein the outwardly extending lever which serves to disengage the coupling is acted upon by a self-locking device such as an inclined surface, an eccentric or the like, substantially as hereinbefore described.

Dated the 28th day of August, 1912.

G. F. REDFERN & Co.,
15, South Street, Finsbury, E.C., and
10, Gray's Inn Place, W.C.,
Agents for the Applicant.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1912.

Fig. 1

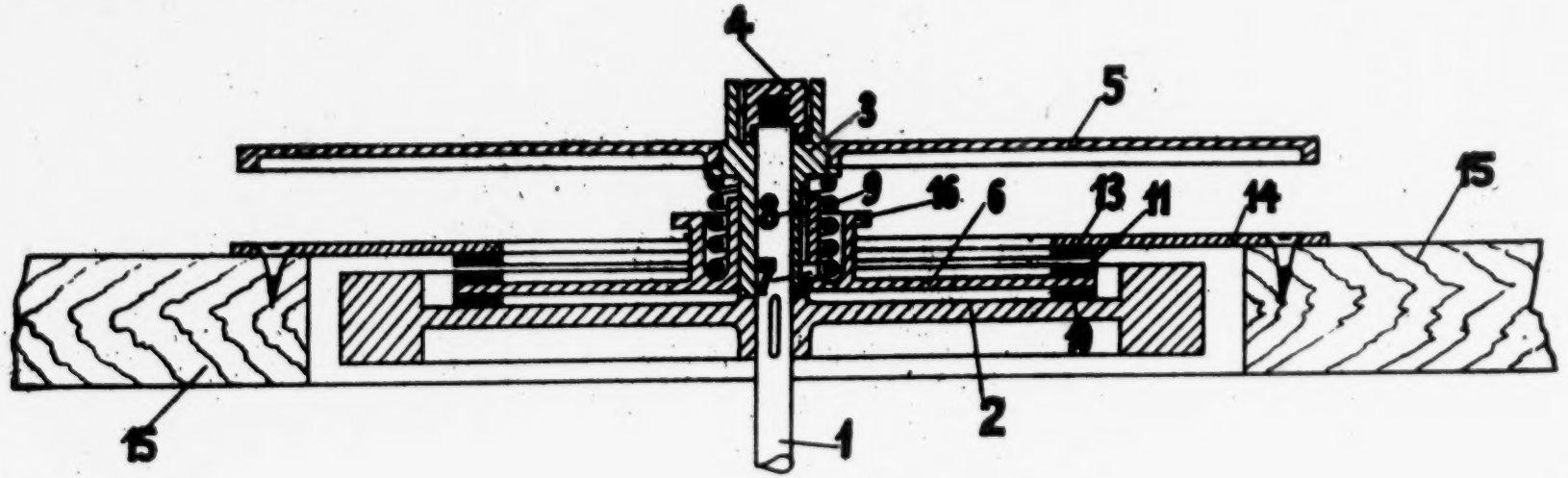
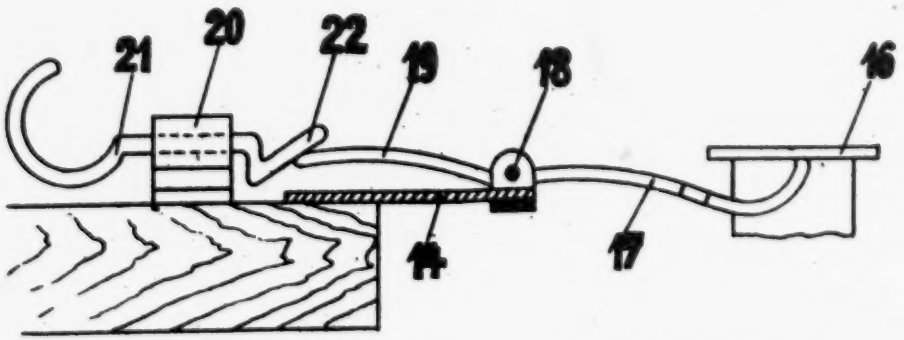


Fig. 2



RÉPUBLIQUE FRANÇAISE.

OFFICE NATIONAL DE LA PROPRIÉTÉ INDUSTRIELLE.

BREVET D'INVENTION.

XII. — **Instruments de précision, électricité.**

2. — APPAREILS DE PHYSIQUE ET DE CHIMIE, OPTIQUE, ACOUSTIQUE.

N° 414.788

Installation pour la commande électrique des plateaux porte-disques dans les phonographes.

COMPAGNIE GÉNÉRALE DE PHONOGRAPHES, CINÉMATOGRAPHES ET APPAREILS DE PRÉCISION résidant en France (Seine).

Demandé le 13 avril 1910.

Délivré le 28 juin 1910. — Publié le 10 septembre 1910.

Les inconvénients des ressorts de barillet utilisés pour transmettre à l'arbre des phonographes à disques son mouvement de rotation, étant bien connus, on a tenté à diverses reprises de remplacer cette commande mécanique, un peu primitive, par une commande électrique. Mais de nouvelles difficultés se présentées, dues aux légères pulsations du moteur qui se traduisent dans une telle application par des mouvements plus ou moins saccadés du disque, rendant une bonne exécution impossible. Les diverses solutions préconisées pour remédier à ce dernier inconvénient conduisant à des dispositifs complexes ou coûteux, la commande électrique des phonographes à disques n'a pu, jusqu'ici, entrer dans le domaine de la pratique.

Cette invention a pour objet une installation pour la commande électrique de l'arbre des phonographes à disques, remarquable en ce qu'elle permet d'assurer au plateau, et par suite au disque, une rotation parfaitement régulière sans entraîner aucune complication mécanique, ni dépense appréciable.

Cette installation se résume dans la combinaison suivante qui est, comme on va le voir, d'une extrême simplicité : Le petit moteur électrique est directement attelé sur l'arbre du de deux poulies dont les diamètres sont dans un rapport convenable et d'une courroie, et le plateau porte-disque est lesté sur sa périphérie par l'adjonction d'une jante lourde venue d'une même pièce ou rapportée, laquelle fait office de volant pendant la rotation de l'arbre et suffit pour assurer la rotation régulière du plateau et du disque et pour supprimer les irrégularités d'exécution que provoquerait l'accouplement direct du moteur sur l'arbre d'un phonographe à plateau ordinaire.

Au dessin annexé, les fig. 1 et 2 représentent, à titre d'exemple, une vue en élévation et une vue en plan de l'installation suivant l'invention :

Les fig. 3, 4, 5 et 6 montrent, en coupe partielle trois variantes du plateau porte-disque pour une telle installation.

Sur la paroi inférieure *a* de la boîte du phonographe est fixée une plate-forme métallique *b* munie d'un bras *c* qui sert à supporter et guider l'arbre vertical *o* du phonographe. D'autre part, sur la paroi verticale *d* de la boîte est fixé, par son socle, un petit moteur électrique *m* de telle manière que son arbre soit disposé verticalement. Une poulie à gorge *f*, de grand diamètre, est calée sur l'arbre *o* du phonographe et une poulie à

[This Drawing is a full size reproduction of the Original.]

Fig.1

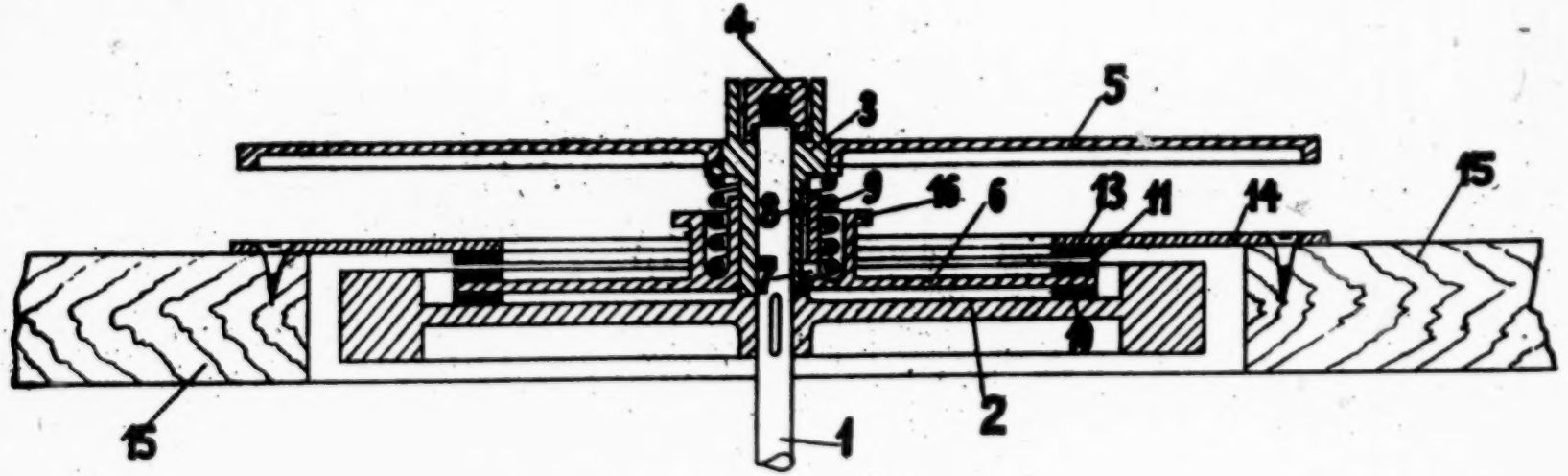
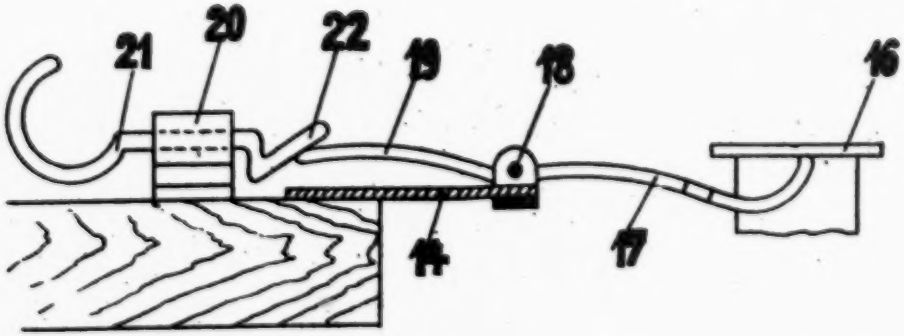


Fig.2



OFFICE NATIONAL DE LA PROPRIÉTÉ INDUSTRIELLE.

BREVET D'INVENTION.

XII. — Instruments de précision, électricité.
2. — Appareils de physique et de chimie, optique, acoustique.

N° 414.788

Installation pour la commande électrique des plateaux porte-disques dans les phonographes.

COMPAGNIE GÉNÉRALE DE PHONOGRAPHES, CINÉMATOGRAPHES ET APPAREILS DE PRÉCISION résidant en France (Seine).

Demandé le 13 avril 1910.
Délivré le 28 juin 1910. — Publié le 10 septembre 1910.

Les inconvénients des ressorts de barillet utilisés pour transmettre à l'arbre des phonographes à disques son mouvement de rotation, étant bien connus, on a tenté à diverses reprises de remplacer cette commande mécanique, un peu primitive, par une commande électrique. Mais de nouvelles difficultés se présentées, dues aux légères pulsations du moteur qui se traduisent dans une telle application par des mouvements plus ou moins saccadés du disque, rendant une bonne exécution impossible. Les diverses solutions préconisées pour remédier à ce dernier inconvénient conduisant à des dispositifs complexes ou coûteux, la commande électrique des phonographes à disques n'a pu, jusqu'ici, entrer dans le domaine de la pratique.

Cette invention a pour objet une installation pour la commande électrique de l'arbre des phonographes à disques, remarquable en ce qu'elle permet d'assurer au plateau, et par suite au disque, une rotation parfaitement régulière sans entraîner aucune complication mécanique, ni dépense appréciable.

Cette installation se résume dans la combinaison suivante qui est, comme on va le voir, d'une extrême simplicité : le petit moteur électrique est directement attelé sur l'arbre du phonographe à disques au moyen, par exemple, de deux poulies dont les diamètres sont dans un rapport convenable et d'une courroie, et le plateau porte-disque est lesté sur sa périphérie par l'adjonction d'une jante lourde venue d'une même pièce ou rapportée, laquelle fait office de volant pendant la rotation de l'arbre et suffit pour assurer la rotation régulière du plateau et du disque et pour supprimer les irrégularités d'exécution que provoquerait l'accouplement direct du moteur sur l'arbre d'un phonographe à plateau ordinaire.

Au dessin annexé, les fig. 1 et 2 représentent, à titre d'exemple, une vue en élévation et une vue en plan de l'installation suivant l'invention :

Les fig. 3, 4, 5 et 6 montrent, en coupe partielle trois variantes du plateau porte-disque pour une telle installation.

Sur la paroi inférieure *a* de la boîte du phonographe est fixée une plate-forme métallique *b* munie d'un bras *c* qui sert à supporter et guider l'arbre vertical *o* du phonographe. D'autre part, sur la paroi verticale *d* de la boîte est fixé, par son socle, un petit moteur électrique *m*, de telle manière que son arbre soit disposé verticalement. Une poulie à gorge *f*, de grand diamètre, est calée sur l'arbre *o* du phonographe et une poulie à gorge *g*, de petit diamètre, est calée, en regard

de la première, sur l'arbre du moteur. Une petite courroie à section ronde ou trapézoïdale relie entre elles les deux poulies.

Sur l'arbre *o* du phonographe repose comme d'ordinaire le plateau métallique *p* servant à porter le disque; mais ce plateau au lieu d'avoir une épaisseur uniforme, est lesté, à sa périphérie, par une sorte de jante *j* de même métal ou en métal plus lourd, en plomb par exemple.

L'installation est complétée par un petit régulateur de vitesse *k* et éventuellement par un lanceur mécanique du type connu, c'est-à-dire comportant un levier horizontal *l* terminé, d'un côté, par une poignée *n* et, de l'autre, par un secteur denté qui engrène avec un pignon cylindrique calé sur l'arbre *o*. Dans le cas où on emploie un tel lanceur, dans l'installation suivant l'invention, le levier *l* portera de préférence un doigt de contact qui fermera le circuit du moteur dès qu'on procédera au lancement et qui interrompra le courant lorsqu'on le ramènera à sa position de repos.

La jante *j* du plateau porte-disque, destinée à former volant pendant la rotation de ce plateau, sera de préférence réservée sur le pourtour même dudit plateau et sur sa face inférieure, comme montré à la fig. 3; mais elle pourrait aussi être réservée sur la face supérieure du plateau, comme montré à la fig. 4 ou répartie au-dessus et au-dessous du plateau comme à la fig. 5.

Cette jante pourra être venue d'une même pièce avec le plateau, mais elle pourrait aussi être rapprochée, ce qui permettrait de la faire en métal plus lourd, en plomb par exemple.

Pour les disques qui ont un rebord décoratif *r* de même épaisseur que le plateau, comme montré à la fig. 6, la jante sera de préférence rapportée sous forme d'une rondelle lourde *j*¹ disposée en contact avec la surface interne de ce plateau, mais elle pourrait aussi être formée par une rondelle entourant extérieurement le plateau et son rebord.

L'invention pourrait, finalement, être réalisée en conservant le plateau usuel sans jante lourde et en constituant cette jante sur le pourtour du disque lui-même qui aurait à cet endroit une très forte surépaisseur, mais il va de soi que le système précédemment décrit est plus pratique et moins coûteux.

RÉSUMÉ.

Cette invention est relative à une installation pour la commande électrique des plateaux porte-disques dans les phonographes, consistant à atteler directement un petit moteur électrique sur l'arbre du phonographe à disques au moyen, par exemple, de deux poulies dont les diamètres sont dans un rapport convenable et d'une courroie, et à monter sur l'arbre du phonographe un plateau porte-disque lesté sur sa périphérie par l'adjonction d'une jante lourde venue d'une même pièce ou rapportée, laquelle fait office de volant pendant la rotation de l'arbre, une telle installation permettant, au moyen d'un groupement mécanique très simple et peu coûteux, d'assurer au phonographe à disques l'avantage de la commande électrique tout en supprimant complètement les irrégularités d'exécution que tendent à provoquer les légères pulsations du moteur électrique.

COMPAGNIE GÉNÉRALE DE PHONOGRAPHES, CINÉMATOGRAPHES ET APPAREILS DE PRÉCISION.

Par procuration :

Lavoix et Mosès.

N° 414.788 — Compagnie Générale de Phonographes, Cinématographes et Appareils de Précision — Pl. unique

FIG_1_

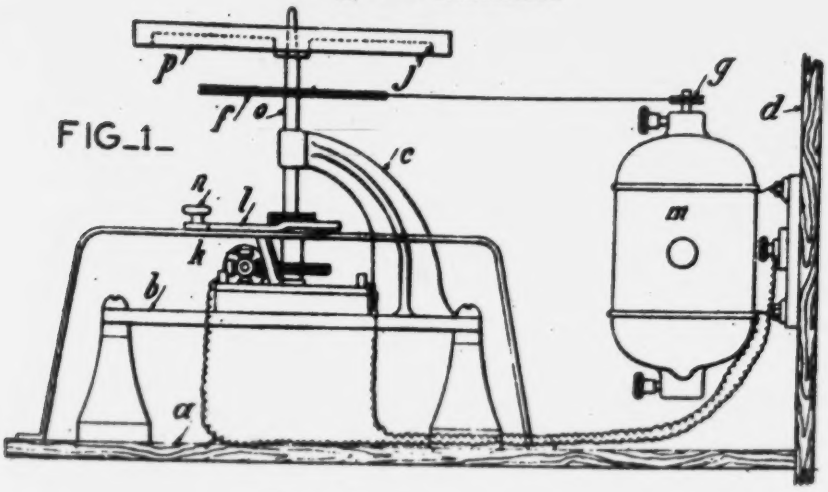


FIG_2_

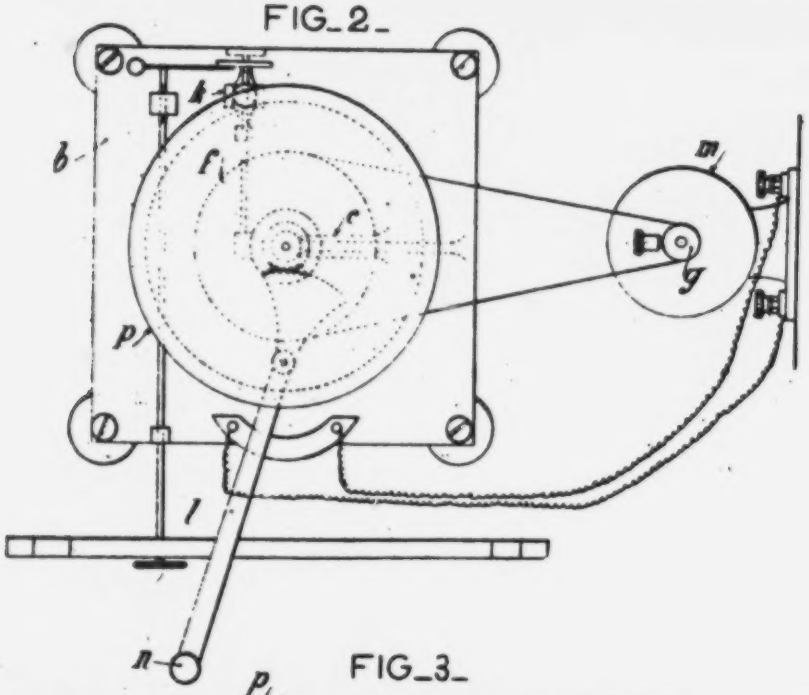


FIG_3_

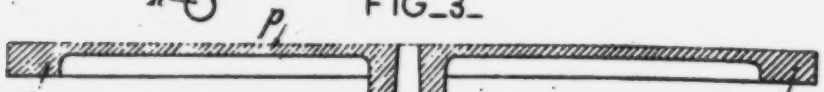


FIG_4_

FIG_5_

FIG_6_

Translation.

French Republic.

FRENCH PATENT AND TRADEMARK OFFICE.
PATENT OF INVENTION.

XII.—Precision instruments, electricity.

No. 414,788

2.—Apparatus for physics and chemistry, optics, acoustics.

Installation for the electric drive of phonograph turntables.

COMPAGNIE GENERALE DE PHONOGRAPHES, CINEMATOGRAPHES et APPAREILS DE PRECISION residing in France (Seine).

Patent applied for on April 13, 1910.
Issued on June 28, 1910.—Published on Sept. 10, 1910.

The drawbacks of the barrel or drum springs used for imparting a rotating motion to the shaft of disc record playing phonographs, are wellknown. It has been tried repeatedly to replace this mechanical drive, which is somewhat primitive, by an electric drive. However, new difficulties have come up due to the slight vibrations of the motor which are manifested in such an application by more-or-less sudden motions of the disc which make a good reproduction impossible. The various solutions suggested to remedy this drawback have led to complex or costly devices and up to the present time the electric drive for disc phonographs could not as yet be introduced in practical operation.

The present invention concerns an installation for the electric drive of the shaft of disc record phonographs, characteristic in that it makes it possible to

assure for the turntable and accordingly for the disc record, a perfectly regular and uniform rotation without any mechanical complications or appreciable expenses.

This installation can be summed up in the following arrangement which, as will be seen, is extremely simple. The small electric motor is directly connected to the shaft of the disc phonograph, for instance, by means of two pulleys, the diameters of which are in a suitable ratio, and of a belt, and the turntable is weighted on its periphery by the adding of a heavy rim which can either be cast integral with it or arranged on it, which serves as flywheel during the rotation of the shaft and suffices to assure the regular (uniform) rotation of the turntable and of the disc and to eliminate the irregularities of reproduction, which would result from a direct coupling of the motor on the shaft of an ordinary turntable phonograph.

In the attached drawing, Figs. 1 and 2 show, by way of example, an elevation view and a plan view of the installation in accordance with the invention:

Figs. 3, 4, 5 and 6 show, in partial section, three variants of the turntable for such an installation.

On the lower wall a of the case or cabinet of the phonograph there is arranged a metallic platform b fitted with an arm c which serves to support and guide the vertical shaft o of the phonograph. On the other hand, to the vertical wall d of the case or cabinet there is attached the base of a small electric motor m, in such a manner that its shaft is arranged vertically. A grooved pulley f, of large diameter, is keyed on the shaft o of the phonograph and a grooved pulley g of small diameter is keyed opposite the first one on the shaft of the motor. A small belt of round or trapezoidal section connects the two pulleys.

On the shaft o of the phonograph there rests, as usual, the metal turntable p which carries the disc

record. However, this turntable, instead of having a uniform thickness, is loaded (weighted) on its periphery by a kind of rim j of the same metal or of heavier metal, for instance of lead.

The installation is completed by a small speed governor k and possibly by a mechanical starter of known type; namely a starter comprising a horizontal lever l, terminated on one end by a handle n and on the other end by a toothed sector, which engages with a cylindrical pinion keyed on the shaft o. In the event that such a starter is used in the installation in accordance with the invention, the lever l carries preferably a contact finger which closes the circuit of the motor immediately upon the starting and which interrupts the current when the starter is brought to its rest position.

The rim j of the turntable destined to form a flywheel during the rotation of the turntable, will preferably be arranged on the periphery of the said turntable and on its lower face, as shown in Fig. 3. But it can also be placed on the upper face of the turntable, as shown in Fig. 4, or spread below and above the plate, as shown in Fig. 5.

This rim may be cast integral with the turntable but it may also be attached to same, which makes it possible to make same of a heavier metal, for instance lead.

For turntable tops which have a decorative edge r of the same thickness as the turntable itself, as shown in Fig. 6, the rim will preferably be arranged in the shape of a heavy ring j^1, arranged in contact with the inner surface of this plate, but it can also be formed by a ring surrounding the turntable and its edge, on the outside.

The invention can finally be carried out by retaining the ordinary turntable without heavy rim and by constituting this rim on the periphery of the plate

of the turntable itself, which, at this place, would thus have a very heavy excess thickness, but it goes without saying that the previously described system is more practical and less costly.

CLAIM.

This invention concerns an installation for the electric drive of phonograph turntables, consisting in connecting directly a small electric motor with a shaft of the disc record phonograph, by means, for instance, of two pulleys, the diameters of which are in a suitable ratio, and by a belt, and to arrange on the shaft of the phonograph a turntable loaded on its periphery by the arrangement of a heavy rim, either integral with the turntable or attached to same, which acts as a flywheel during the rotation of the shaft, such an installation making it possible, by means of a simple and economical mechanical grouping, to assure for disc record phonographs the advantage of electric drives, while completely eliminating the irregularities of reproduction which the slight pulsations of the electric motor tend to cause.

COMPAGNIE GENERALE DE PHONOGRAPHES,
CINEMATOGRAPHES
ET APPAREILS DE PRECISION.

By: Lavoix & Moses,
Agents.

REPUBLIQUE FRANÇAISE.

OFFICE NATIONAL DE LA PROPRIÉTÉ INDUSTRIELLE.

BREVET D'INVENTION.

XII. **Instruments de précision, électricité.**

2. — APPAREILS DE PHYSIQUE ET DE CHIMIE, OPTIQUE, ACOUSTIQUE.

N° 416.838

Appareil pour la mise en mouvement des disques et cylindres appliqués à toutes sortes de machines parlantes.

M. EDUARDO LOPEZ MARTINEZ résidant en Espagne.

Demandé le 6 juin 1910.

Délivré le 17 août 1910. — Publié le 29 octobre 1910.

L'appareil faisant l'objet de cette invention est susceptible de s'appliquer à toutes sortes de machines parlantes à disques, cylindres, rubans, etc., pour la reproduction de la voix, monologues, chants, etc., des morceaux de musique, ou autres sons. Pour sa démonstration, on supposera l'objet de l'invention appliqué à la classe d'appareils dits « gramophones » qui pourra être dénommé par exemple « électrogramophone ».

L'appareil suivant l'invention est susceptible de se fabriquer sous deux principales formes d'exécution décrites ci-après, le principe de l'invention proprement dit restant le même.

Dans les dessins ci-joints donnés à titre d'exemple et représentant l'objet de l'invention :

La fig. 1 est une vue en plan.

Les fig. 2, 3, 4 et 5 sont des vues de détail.

La fig. 6 est une vue d'une variante d'exécution.

Les autres figures sont des détails.

L'appareil comprend trois dispositifs mécaniques : le mouvement d'horlogerie avec commande par une corde pour une ou quelques auditions (selon le genre de l'appareil), le mécanisme électrique ayant la propriété de fonctionner avec n'importe quelle sorte de courant électrique, sur lequel on se dérive et celui d'embrayage ou désembrayage pour employer indistinctement la force électrique ou celle du ressort. On s'occupera seulement que des mécanismes électriques et d'embrayage ou de débrayage, celui d'horlogerie étant suffisamment connu et le système en lui-même important peu tant qu'il remplira les conditions de légèreté, de volume et de transmission appropriées.

Le mécanisme électrique est composé d'un moteur de système quelconque M, fig. 1, d'un régulateur R, du rhéostat N, de la résistance L et la colonne C, avec l'axe E qui soutient le plateau W, fig. 2, où se placent les disques.

Le régulateur à force centrifuge R, fig. 1, est composé de deux parties : le régulateur proprement dit et la tige de réglage filetée T, avec ses pièces de soutien *c' c'* et le levier *p* avec le frein *f*.

Le rhéostat N a pour objet de régler le courant qui circule dans le moteur M aux vitesses différentes selon ses résistances; celui employé ici est du type circulaire et à huit contacts qui produisent autant de variations de l'intensité et de la vitesse. Le premier plot à gauche interrompt le circuit.

La lampe de résistance est montée sur une pièce isolante k, par une douille L'; elle sert à régler l'intensité du courant; on emploie des

lampes de 5 à 16 bougies, selon le genre de moteur et la nature du courant.

L'axe vertical E est soutenu par la pièce C, comme montré sur les figures 1 et 2.

Cet axe porte à sa partie supérieure une poulie V, montée folle, qui possède quatre dents *g* dans sa partie inférieure; cette poulie est fixée par des vis *d* au support C, et la pièce D a pour objet d'éviter que la poulie V descende par son propre poids. Sur la partie inférieure de la pièce D se trouve un manchon F assujetti à l'axe au moyen de vis *s*. Ce manchon a dans sa partie supérieure quatre dents semblables à celles de la poulie V pour pouvoir engrener avec elles.

Plus bas se trouve la roue B avec engrenage conique. Cette roue se trouve parfaitement assujettie à l'axe E par la vis *s'*; il sert pour transmettre à celui-ci le mouvement qu'il reçoit du pignon *r*. L'extrémité inférieure est logée dans une boîte à coussinet A, voir fig. 4.

A la base de la colonne C se trouve la poulie R montée sur l'axe *e*, et son extrémité antérieure assujettie au pignon *r*, dont la denture est semblable à celle de la roue B. Cette poulie est soutenue par deux pièces *b b* et elle est reliée à la poulie Q du moteur par une transmission de courroie sans fin et l'autre poulie P du moteur est reliée par une autre transmission, avec la roue S du régulateur centrifuge.

Pour la bonne marche de l'appareil, on établit la relation existante entre la roue B et le pignon *r*, dans le rapport de 1/3, ainsi que celle des poulies R et Q.

La relation de la poulie S du régulateur, avec celle P du moteur est de 1/2, de telle sorte que chaque tour de l'axe E (qui soutient le plateau) correspond approximativement à 9 tours de l'induit du moteur et à 18 du régulateur. De cette façon, on obtient un bon entraînement des disques et une marche parfaite de l'appareil.

Le mécanisme d'horlogerie Y possède un axe H, qui supporte en général le plateau de la machine parlante; on fixe par une vis *x* une poulie Z de même diamètre que celle V de l'axe E, avec laquelle elle est reliée par une transmission sans fin.

L'appareil pour embrayer ou débrayer est constitué par un coin O (voir les figures 2 et 3) qui est commandé au moyen d'une pièce O' représentée en fig. 5. Ce coin pénètre dans la rainure *k* de la boîte A en le poussant et sortant quand on le tire en restant limité dans son mouvement par *t*.

Les différentes pièces du mécanisme ayant été expliquées, en supposant qu'on veuille faire fonctionner l'appareil avec le courant électrique, on commence par attirer la pièce O' au dehors et à droite; de cette manière, le coin ou chevet O prendra la position indiquée dans la fig. 2, puis on fait tourner à gauche quelques tours à la tige de réglage T pour éloigner légèrement le frein *f* du plateau *p'* du régulateur, en libérant celui-ci, et il ne reste qu'à tirer doucement la pièce N' du rhéostat N qui fermera le circuit, en fermant le courant sur le moteur, le mouvement se transmettant au régulateur à la poulie R par l'intermédiaire du pignon *p* et de la roue B à l'axe E et au plateau.

Comme la poulie V est reliée à celle de l'appareil d'horlogerie qui n'est pas embrayée, elle ne pourra pas agir et elle restera sans action.

Avec la tige de réglage T du régulateur et le rhéostat, on gradue, de façon voulue, la marche au point désiré pour les disques, le réglage de l'appareil reste ainsi pour les auditions suivantes pour lesquelles on n'a qu'à changer les disques.

Dans le cas où l'on n'a pas de courant à sa disposition, ou pour d'autre causes, si on désire mettre en fonction le mécanisme d'horlogerie, on remonte celui-ci avec la manivelle X (fig. 1) et on pousse la pièce O' à gauche par le moyen de laquelle le coin O pénètre dans le logement *k* de la boîte à coussinet A obligeant l'axe E à monter par suite du glissement de son extrémité inférieure sur le plan incliné, montré en pointillé sur la fig. 5, et en même temps la roue dentée B se dégage du pignon *p* et les dents du manchon F engrènent avec ceux de la poulie V, en couplant de cette façon l'axe E et en l'entraînant dans son mouvement de rotation, qu'elle reçoit de la poulie Z, par la transmission *a''*. Cet appareil doit posséder un régulateur propre, comme tous ceux de son genre déjà connus.

On aurait pu employer les engrenages pour transmettre le mouvement, mais la pratique a démontré que les meilleurs résultats

ent été fournis par les courroies et transmissions métalliques, constituées par un fil de laiton ou acier relié en spirale et avec ses extrémités unies.

Dans les machines parlantes qui sont construites pour fonctionner uniquement par l'électricité, on supprime les coins O, la poulie V, le manchon F et le mécanisme d'horlogerie.

Si l'on désire faire fonctionner l'appareil avec des piles ou des accumulateurs, on change la lampe résistance par un bouchon à vis qui ferme le circuit et ne forme pas résistance.

Dans la boîte de la machine et dans un endroit approprié, on a prévu un coupe-circuit fusible qui permettra de manier l'appareil sans aucun risque.

Dans la deuxième forme d'exécution montrée dans la figure 6 et les suivantes, le mécanisme électrique consiste en un électromoteur M (fig. 6) avec son rhéostat N; un régulateur à force centrifuge R, une lampe résistance L, un ferme-circuit U avec son fusible et un interrupteur *rr*. Outre la colonne C qui soutient l'axe E et qui supporte le plateau où se placent les disques. Le moteur M est semblable à celui décrit en premier lieu, l'axe de rotation est vertical et fixe à son extrémité supérieure par une vis de pression, fig. 10, il porte une double poulie P et Q, ayant entre elles une relation de diamètres approximative de 1/3. Le régulateur à force centrifuge R, outre de sa tige filetée T pour augmenter ou diminuer le nombre de révolutions, porte fixé à sa partie supérieure, une autre poulie R ayant une relation de 1/2 avec celle P du moteur. On ne décrit pas les autres éléments qui sont bien connus.

Le mécanisme pour embrayer ou débrayer est composé de l'axe (fig. 7 et suivantes), soutenu par la colonne C et porte deux poulies : celle S ayant un diamètre approximativement double de celui P du moteur, soutenu par la partie coudée de ladite colonne C et celle V (moitié de l'antérieur), soutenue par la pièce en équerre D. Ces poulies tournent autour de l'axe E et par leur propre poids; elles sont toujours en contact avec les pièces qui les supportent. Assujetties à l'axe mendisposés dans la position signalée sur leslites figures. L'axe E fini par sa partie inférieure par un pivot pénétrant dans la boîte coussinet A. Le coin O le faisant par son plan incliné monter ou descendre, suivant qu'on le pousse en avant ou en dehors de son logement. Dessous le pivot et au-dessus du coin, il y a une biell. en acier pour diminuer les frottements.

La disposition des anneaux F et F' est telle que quand l'axe se trouve dans sa position plus basse (fig. 7), la partie supérieure est embrayée avec les dents *g* qui portent la poulie S et celle inférieure débrayée. Au contraire, quand l'axe monte (fig. 10) par suite de la poussée du coin dans le coussinet A, l'anneau inférieur embraye avec la poulie V et celui supérieur laisse libre S.

Le mécanisme d'horlogerie porte l'axe H (le nombre des révolutions étant approprié pour l'audition des disques ou autres impressionnés) sur lequel est montée la poulie Z qui a un diamètre égal à celle V montée dans la colonne centrale G de l'appareil.

Pour communiquer le mouvement, on emploie des transmissions métalliques constituées par une spirale en fil de laiton ou en acier repliée à la longueur désirée, et qui, par son élasticité, facilite ainsi l'assemblage des poulies entre elles, tout en absorbant les changements brusques de vitesse que peut produire le moteur. La poulie P du moteur est couplée à celle R du régulateur; celle Q du moteur avec la roue S de l'axe E et la poulie V avec la roue Z de l'appareil d'horlogerie Y.

On tire le coin O en dehors; de cette façon l'axe E, en vertu de son propre poids et de celui du plateau qui soutient, descendra à sa position plus inférieure (fig. 7) et embrayera la bague F' avec la poulie S en débrayant la roue F de la poulie V, c'est-à-dire que l'axe E restera couplé à la poulie S et celle V sera libérée.

Ceci fait, on ferme le circuit dans le rhéostat au moyen de l'interrupteur, le moteur se mettra en mouvement entraînant (au moyen de la transmission *n'*) la poulie S de l'axe E et le plateau.

Le mouvement est complètement uniforme, parce que le régulateur est assemblé à l'induit

moteur et la nature du courant.

L'axe vertical E est soutenu par la pièce C, comme montré sur les figures 1 et 2.

Cet axe porte à sa partie supérieure une poulie V, montée folle, qui possède quatre dents *g* dans sa partie inférieure; cette poulie est fixée par des vis *d* au support C, et la pièce D a pour objet d'éviter que la poulie V descende par son propre poids. Sur la partie inférieure de la pièce D se trouve un manchon F assujetti à l'axe au moyen de vis *s*. Ce manchon a dans sa partie supérieure quatre dents semblables à celles de la poulie V pour pouvoir engrener avec elles.

Plus bas se trouve la roue B avec engrenage conique. Cette roue se trouve parfaitement assujettie à l'axe E par la vis *s'*; il sert pour transmettre à celui-ci le mouvement qu'il reçoit du pignon *r*. L'extrémité inférieure est logée dans une bolte à coussinet A, voir fig. 4.

A la base de la colonne C se trouve la poulie R montée sur l'axe *e*, et son extrémité antérieure assujettie au pignon *r*, dont la denture est semblable à celle de la roue B. Cette poulie est soutenue par deux pièces *b b* et elle est reliée à la poulie Q du moteur par une transmission de courroie sans fin et l'autre poulie P du moteur est reliée par une autre transmission, avec la roue S du régulateur centrifuge.

Pour la bonne marche de l'appareil, on établit la relation existante entre la roue B et le pignon *r*, dans le rapport de 1/3, ainsi que celle des poulies R et Q.

La relation de la poulie S du régulateur, avec celle P du moteur est de 1/2, de telle sorte que chaque tour de l'axe E (qui soutient le plateau) correspond approximativement à 9 tours de l'induit du moteur et à 18 du régulateur. De cette façon, on obtient un bon entraînement des disques et une marche parfaite de l'appareil.

Le mécanisme d'horlogerie Y possède un axe H, qui supporte en général le plateau de la machine parlante; on fixe par une vis *x* une poulie Z de même diamètre que celle V de l'axe E, avec laquelle elle est reliée par une transmission sans fin.

L'appareil pour embrayer ou débrayer est constitué par un coin O (voir les figures 3 pièce O' représentée en fig. 5. Ce coin pénètre dans la rainure *h* de la bolte A en le poussant et sortant quand on le tire en restant limité dans son mouvement par *t*.

Les différentes pièces du mécanisme ayant été expliquées, en supposant qu'on veuille faire fonctionner l'appareil avec le courant électrique, on commence par attirer la pièce O' au dehors et à droite; de cette manière, le coin ou chevet O prendra la position indiquée dans la fig. 2, puis on fait tourner gauche quelques tours à la tige de réglage T pour éloigner légèrement le frein *f* du plateau *p'* du régulateur, en libérant celui-ci, et il ne reste qu'à tirer doucement la pièce N' du rhéostat N qui fermera le circuit, en fermant le courant sur le moteur, le mouvement se transmettant au régulateur à la poulie R par l'intermédiaire du pignon *p* et de la roue B à l'axe E et au plateau.

Comme la poulie V est reliée à celle de l'appareil d'horlogerie qui n'est pas embrayée, elle ne pourra pas agir et elle restera sans action.

Avec la tige de réglage T du régulateur et le rhéostat, on gradue, de façon voulue, la marche au point désiré pour les disques, le réglage de l'appareil reste ainsi pour les auditions suivantes pour lesquelles on n'a qu'à changer les disques.

Dans le cas où l'on n'a pas de courant à sa disposition, ou pour d'autre causes, si on désire mettre en fonction le mécanisme d'horlogerie, on remonte celui-ci avec la manivelle X (fig. 1) et on pousse la pièce O' à gauche par le moyen de laquelle le coin O pénètre dans le logement *h* de la bolte à coussinet A obligeant l'axe E à monter par suite du glissement de son extrémité inférieure sur le plan incliné, montré en pointillé sur la fig. 5, et en même temps la roue dentée B se dégage du pignon *p* et les dents du manchon F engrènent avec ceux de la poulie V, en couplant de cette façon l'axe E et en l'entraînant dans son mouvement de rotation, qu'elle reçoit de la poulie Z, par la transmission *a''*. Cet appareil doit posséder un régulateur propre, comme tous ceux de son genre déjà connus.

On aurait pu employer les engrenages pour transmettre le mouvement, mais la pratique a démontré que les meilleurs résultats

ont été fournis par les courroies et transmissions métalliques, constituées par un fil de laiton ou acier relié en spirale et avec ses extrémités unies.

Dans les machines parlantes qui sont construites pour fonctionner uniquement par l'électricité, on supprime les coins O, la poulie V, le manchon F et le mécanisme d'horlogerie.

Si l'on désire faire fonctionner l'appareil avec des piles ou des accumulateurs, on change la lampe résistance par un bouchon à vis qui ferme le circuit et ne forme pas résistance.

Dans la boîte de la machine et dans un endroit approprié, on a prévu un coupe-circuit fusible qui permettra de manier l'appareil sans aucun risque.

Dans la deuxième forme d'exécution montrée dans la figure 6 et les suivantes, le mécanisme électrique consiste en un électromoteur M (fig. 6) avec son rhéostat N; un régulateur à force centrifuge R, une lampe résistance L, un ferme-circuit U avec son fusible et un interrupteur *rr*. Outre la colonne C qui soutient l'axe E et qui supporte le plateau où se placent les disques. Le moteur M est semblable à celui décrit en premier lieu, l'axe de rotation est vertical et fixe à son extrémité supérieure par une vis de pression, fig. 10, il porte une double poulie P et Q, ayant entre elles une relation de diamètres approximative de 1/3. Le régulateur à force centrifuge R, outre de sa tige filetée T pour augmenter ou diminuer le nombre de révolutions, porte fixé à sa partie supérieure, une autre poulie R ayant une relation de 1/2 avec celle P du moteur. On ne décrit pas les autres éléments qui sont bien connus.

Le mécanisme pour embrayer ou débrayer est composé de l'axe (fig. 7 et suivantes), soutenu par la colonne C et porte deux poulies : celle S ayant un diamètre approximativement double de celui P du moteur, soutenu par la partie coudée de ladite colonne C et celle V (moitié de l'antérieur), soutenue par la pièce en équerre D. Ces poulies tournent autour de l'axe E et par leur propre poids; elles sont toujours en contact avec les pièces qui les supportent. Assujetties à l'axe mentionné, au moyen des vis de pression *s* et *s'*, deux cylindres ou anneaux dentés F et F' sont disposés dans la position signalée sur lesdites figures. L'axe E fini par sa partie inférieure par un pivot pénétrant dans la boîte coussinet A. Le coin O le faisant par son plan incliné monter ou descendre, suivant qu'on le pousse en avant ou en dehors de son logement. Dessous le pivot et au-dessus du coin, il y a une bielle en acier pour diminuer les frottements.

La disposition des anneaux F et F' est telle que quand l'axe se trouve dans sa position plus basse (fig. 7), la partie supérieure est embrayée avec les dents *g* qui portent la poulie S et celle inférieure débrayée. Au contraire, quand l'axe monte (fig. 10) par suite de la poussée du coin dans le coussinet A, l'anneau inférieur embraye avec la poulie V et celui supérieur laisse libre S.

Le mécanisme d'horlogerie porte l'axe H (le nombre des révolutions étant approprié pour l'audition des disques ou autres impressionnés) sur lequel est montée la poulie Z qui a un diamètre égal à celle V montée dans la colonne centrale G de l'appareil.

Pour communiquer le mouvement, on emploie des transmissions métalliques constituées par une spirale en fil de laiton ou en acier repliée à la longueur désirée, et qui, par son élasticité, facilite ainsi l'assemblage des poulies entre elles, tout en absorbant les changements brusques de vitesse que peut produire le moteur. La poulie P du moteur est couplée à celle R du régulateur; celle Q du moteur avec la roue S de l'axe E et la poulie V avec la roue Z de l'appareil d'horlogerie Y.

On tire le coin O en dehors; de cette façon l'axe E, en vertu de son propre poids et de celui du plateau qui soutient, descendra à sa position plus inférieure (fig. 7) et embrayera la bague F' avec la poulie S en débrayant la roue F de la poulie V, c'est-à-dire que l'axe E restera couplé à la poulie S et celle V sera libérée.

Ceci fait, on ferme le circuit dans le rhéostat au moyen de l'interrupteur, le moteur se mettra en mouvement entraînant (au moyen de la transmission *a'*) la poulie S de l'axe E et le plateau.

Le mouvement est complètement uniforme, parce que le régulateur est assemblé à l'induit du moteur par le moyen de la transmission et en réglant sa rotation, ce qui est précisément

la base essentielle de tout le mécanisme. Comme on peut le voir dans la fig. 10, il augmente ou diminue la vitesse de rotation seulement en tournant dans un sens ou dans l'autre la tige de réglage T du régulateur. Comme la poulie V qui est reliée à celle Z du mécanisme d'horlogerie par la transmission a'' est libre autour de l'axe E, elle reste en repos comme le mécanisme. Pour suspendre ou arrêter l'appareil, il suffit de fermer le courant dans le rhéostat ou dans l'interrupteur.

Quand on désire le fonctionnement par le moyen du mécanisme d'horlogerie, on pousse le coin O en dedans comme représenté en fig. 10; l'axe E glissant sur le plan incliné du coin monte, obligeant l'anneau F à embrayer avec la poulie V par sa partie inférieure et à débrayer la poulie s qui reste libre. Ceci fait, on met en mouvement le mécanisme d'horlogerie, l'axe H et la poulie Z transmettent par le moyen de la transmission a'', le mouvement à la poulie V et par conséquent l'axe E et au plateau, la poulie S et le moteur électrique restant libre.

Pour les auditions successives, on réglera le mécanisme au point voulu, au moyen de la tige filetée du régulateur, qui est indépendant du système d'actionnement électrique. On peut fabriquer les appareils exclusivement pour être actionnés par le courant électrique; dans ce cas, la colonne C (fig. 8), porte l'axe E avec la poulie S, maintenue par une vis de pression E, en supprimant tout ce qui est relatif aux mécanismes d'horlogerie, d'embrayage et de débrayage.

Si, au lieu de disques, on fait usage de cylindres ou de rubans impressionnés, le mouvement de l'axe E (fig. 9) se transmettra à un arbre secondaire E' par le moyen d'un système d'engrenages sur lequel sont montés les cylindres r et r' entre lesquels passe le ruban ou bien le mandrin métallique V sur lequel on placera les cylindres en cire ou autre substance impressionnée.

RÉSUMÉ.

L'invention comprend l'application de deux forces, électrique et mécanique (ressort) pour l'actionnement des machines parlantes à disques, cylindres ou rubans.

Le dispositif mécanique mû électriquement par lequel la force de l'induit du moteur est employée pour la mise en mouvement des disques, cylindres ou rubans ou autres, dans des machines parlantes, en combinaison avec un régulateur mécanique.

Le dispositif pour embrayer et débrayer le mécanisme d'actionnement.

Eduardo Lopez MARTINEZ.

Par procuration :

DE BOUGÉ.

Fig. 6

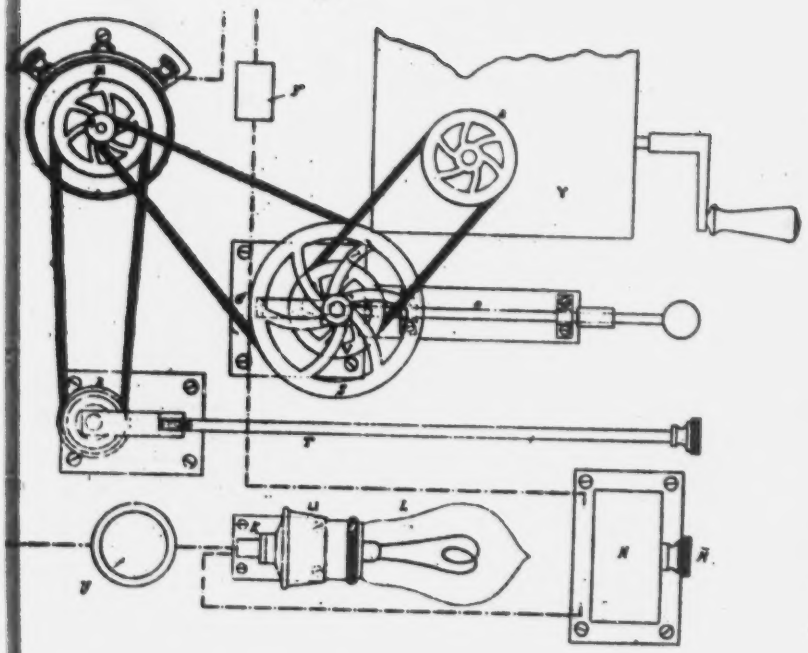


Fig. 7

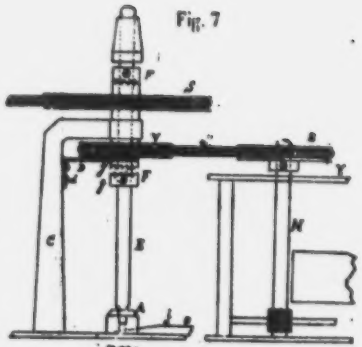


Fig. 8

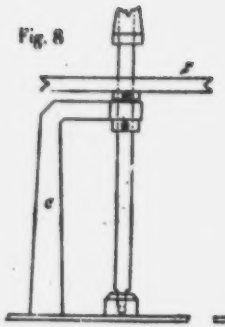
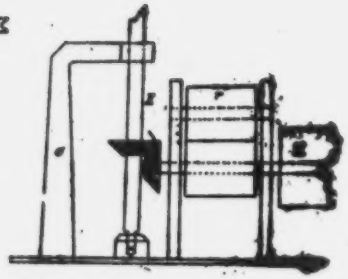


Fig. 9



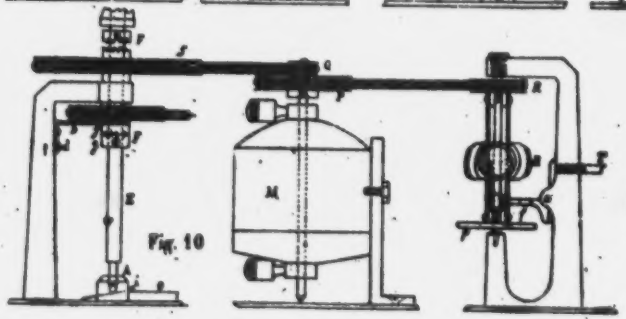


Fig. 10

Fig. 11

la base essentielle de tout le mécanisme. Comme on peut le voir dans la fig. 10, il augmente ou diminue la vitesse de rotation seulement en tournant dans un sens ou dans l'autre la tige de réglage T du régulateur. Comme la poulie V qui est reliée à celle Z du mécanisme d'horlogerie par la transmission a'' est libre autour de l'axe E, elle reste en repos comme le mécanisme. Pour suspendre ou arrêter l'appareil, il suffit de fermer le courant dans le rhéostat ou dans l'interrupteur.

Quand on désire le fonctionnement par le moyen du mécanisme d'horlogerie, on pousse le coin O en dedans comme représenté en fig. 10; l'axe E glissant sur le plan incliné du coin monte, obligeant l'anneau F à embrayer avec la poulie V par sa partie inférieure et à débrayer la poulie s qui reste libre. Ceci fait, on met en mouvement le mécanisme d'horlogerie, l'axe H et la poulie Z transmettent par le moyen de la transmission a'', le mouvement à la poulie V et par conséquent l'axe E et au plateau, la poulie S et le moteur électrique restant libre.

Pour les auditions successives, on réglera le mécanisme au point voulu, au moyen de la tige filetée du régulateur, qui est indépendant du système d'actionnement électrique. On peut fabriquer les appareils exclusivement pour être actionnés par le courant électrique; dans ce cas, la colonne C (fig. 8), porte l'axe E avec la poulie S, maintenue par une vis de pression E, en supprimant tout ce qui est relatif aux mécanismes d'horlogerie, d'embrayage et de débrayage.

Si, au lieu de disques, on fait usage de cylindres ou de rubans impressionnés, le mouvement de l'axe E (fig. 9) se transmettra à un arbre secondaire E' par le moyen d'un système d'engrenages sur lequel sont montés les cylindres r et r' entre lesquels passe le ruban ou bien le mandrin métallique N sur lequel on placera les cylindres en cire ou autre substance impressionnée.

RÉSUMÉ.

L'invention comprend l'application de deux forces, électrique et mécanique (ressort) pour l'actionnement des machines parlantes à disques, cylindres ou rubans.

Le dispositif mécanique mû électriquement par lequel la force de l'induit du moteur est employée pour la mise en mouvement des disques, cylindres ou rubans ou autres, dans des machines parlantes, en combinaison avec un régulateur mécanique.

Le dispositif pour embrayer et débrayer le mécanisme d'actionnement.

EDUARDO LOPEZ MARTINEZ.

Par procuration :
DE BONNÉ.

Pour la vente, s'adresser à l'IMPRIMERIE NATIONALE, 87, rue Vieille-du-Temple. Paris (3e).

Fig. 6

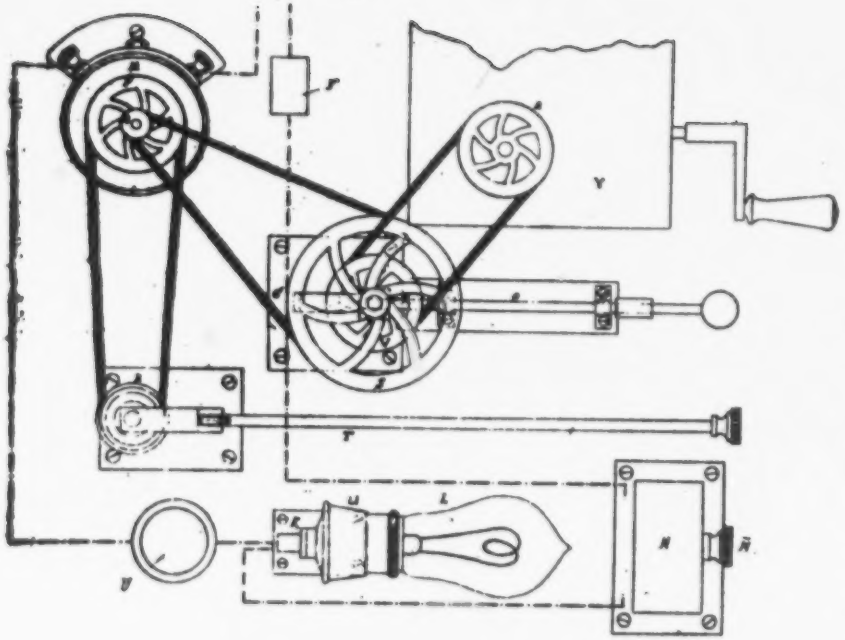


Fig. 7

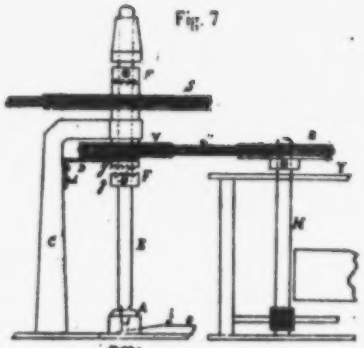


Fig. 8

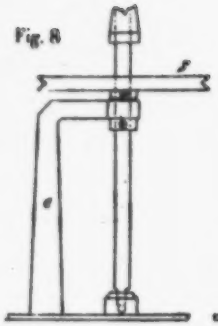


Fig. 9

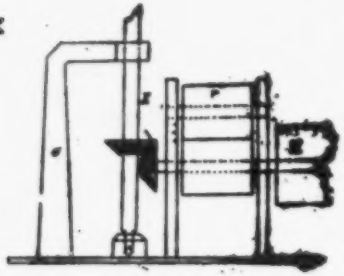


Fig. 10

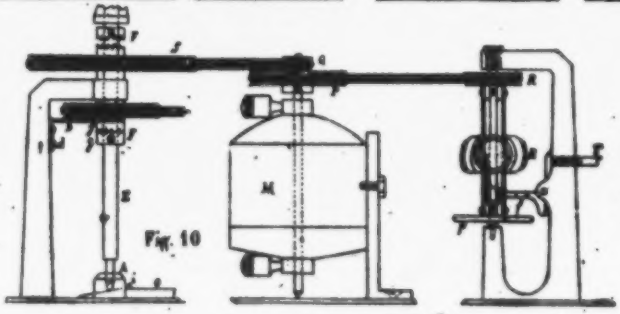


Fig. 11

Fig. 1

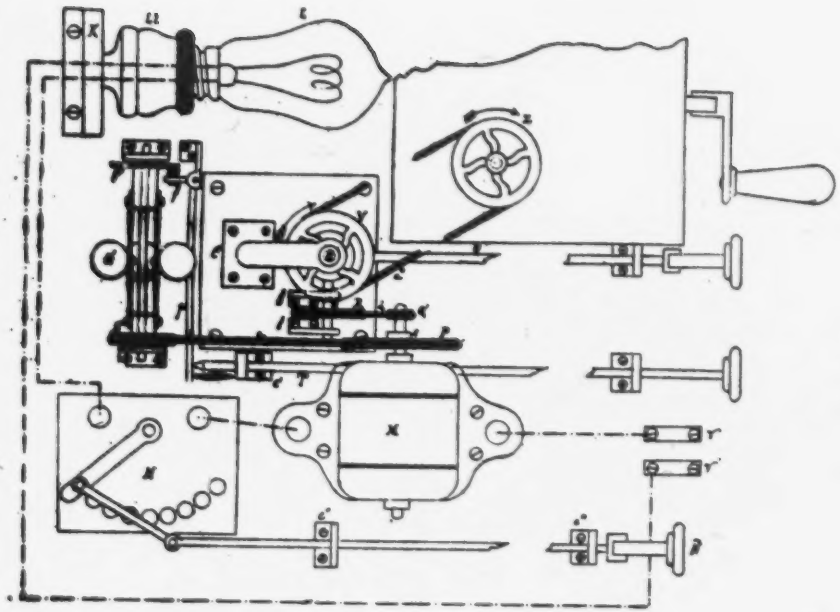


Fig. 2

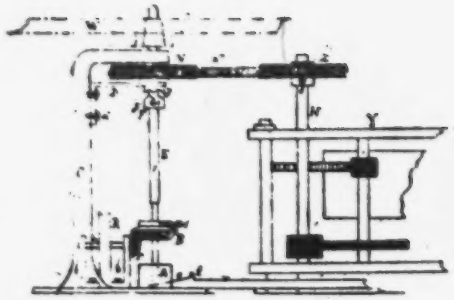


Fig. 3

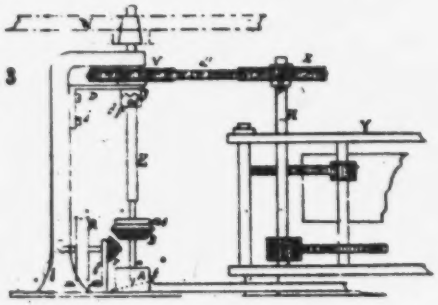


Fig. 4

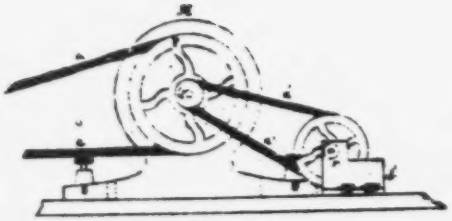
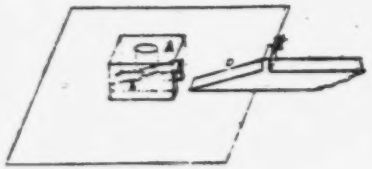


Fig. 5



Translation.

French Republic

French Patent and Trademark Office
PATENT OF INVENTION

XII.—Precision instruments, electricity.

2.—Apparatus for physics and chemistry, optics and acoustics. No. 416,838.

Apparatus for the starting of disc and cylinder records in connection with all kinds of talking machines.

Eduardo Lopez Martinez, residing in Spain.
Patent applied for on June 6, 1910.

Issued on August 17, 1910.—Published on October 29, 1910.

The apparatus which is the subject matter of this invention can be applied to any kind of talking machines using disc records, cylinder records, films, etc., for the reproduction of voice, monologues, songs, etc., of musical pieces or other sounds. For its demonstration let us suppose that the subject matter of the invention is applied to the so-called gramophones or phonographs, which may be called for instance electro-gramophones or phonographs.

The apparatus in accordance with the invention can be manufactured in two principal manners of execution described below, the principle of the invention proper remaining the same.

In the attached drawing given by way of example, and showing the subject matter of the invention,

Fig. 1 is a plan view,

Figs. 2, 3, 4 and 5 are detailed views,

Fig. 6 is a view of a variant of execution;

The other figures show details.

The apparatus comprises three mechanical devices, namely:

The clock movement with cord drive for one or several auditions (in accordance with the kind of apparatus);

The electric mechanism which can operate with any kind of current with which it is connected, and

The engaging and disengaging mechanism to use either electric power or spring power, as desired.

We shall only mention here the electric mechanism and the engaging and disengaging mechanism, as the clock work movement is sufficiently wellknown and is of itself of little importance, as long as it complies with the requirements of light weight, suitable volume and transmission.

The electric mechanism consists of a motor of any system M (Fig. 1), of a governor R, of the rheostat N, of the resistance L and the column C with the shaft E which holds the turntable W (Fig. 2) on which the disc records are placed.

The centrifugal governor R′, Fig. 1, consists of two parts, namely the governor proper and the threaded regulating rod T with its supporting member c′c′ and the lever p with the brake f.

The rheostat N serves to regulate the current which flows in the motor M at the different speeds in accordance with its resistances; the one used here is of the circular type, with 8 contacts, which produce a like number of variations of intensity and of speed. The first contact on the left interrupts the circuit.

The resistance lamp is mounted on an insulating member K, by means of a socket L′. It serves to regulate the intensity of the current. There are used

lamps of from 5 to 16 candle power, in accordance with the type of motor and the kind of current.

The vertical shaft E is supported by the part C, as shown in Fig. 1 and 2.

This shaft is fitted at its upper part with a pulley V, mounted in an idle manner, which has four teeth g in its lower part; this pulley is fixed by screws d to to the Support C and the purpose of the Part D is to avoid that pulley V descends by its own weight. On the lower portion of part D there is a sleeve F, fixed to the shaft by means of screw s. This sleeve is fitted in its upper part with four teeth similar to those of pulley V which is destined to engage with same.

Lower down we find the wheel B with bevel gear. This wheel is securely attached to the shaft E by the screw s'. This gear serves to transmit to the shaft E the motion which it receives from the pinion r. The lower extremity fits into a bearing box A, see Fig. 4.

On the base of the column C, the pulley R is mounted on the shaft e, and its front end (extremity) is attached to the pinion r, the teeth of which are similar to the teeth of gear B. This pulley is held by two parts bb and is connected with pulley Q of the motor by an endless belt transmission and the other pulley P of the motor is connected, by means of another transmission, with the wheel S of the centrifugal governor.

In order for the apparatus to operate in a satisfactory manner, the ratio between the gear B and the pinion r is fixed at 1:3 which is also the ratio of pulleys R and Q.

The ratio between the pulley S of the governor and pulley P of the motor is 1:2, so that to each rotation of the shaft E (which supports the turn table) there corresponds about 9 rotations of the armature of the motor and 18 rotations of the governor. In this manner satisfactory motion is imparted to the disc records and the apparatus operates perfectly.

The clockwork mechanism Y is fitted with a shaft H which generally supports the turn table of the talking machine. There is attached by means of a screw s, a pulley Z of the same diameter as that of pulley V of the shaft E, with which pulley there is connected pulley Z by an endless belt.

The apparatus for engaging or disengaging is constituted by a wedge O (See Fig. 2 and 3), which is operated by means of a part O′ shown in Fig. 5. This wedge enters the groove h of the box A when pushed and leaves same when pulled, being limited in its motion by t.

The different parts of the mechanism having been explained and assuming that it is desired to operate same on electric current, one starts by pulling the part O outwards, to the right; in this manner, the wedge O will take the position shown in Fig. 2; then the regulating rod T is given a few turns to the left, in order to remove the brake f slightly from the plate p′ of the governor, which releases the latter; it now only remains to pull the part N′ of the rheostat N slightly, which will close the circuit, closing the current on the motor, the movement being transmitted from the governor to pulley R through the pinion p and from the gear B to the shaft E and to the turn-table. (Translator's Note: We have changed "au" into "du" in line 71 (to into from..pulley R) as this seemed to us to be the only way in which this sentence would make sense).

As the pulley V is connected with the pulley of the clockwork mechanism, the latter pulley not being engaged, it will be prevented from acting and will not act.

By means of the regulating rod T of the governor and by means of the rheostat, the operation is graduated as desired for the disc records; thus the regulation of the apparatus remains the same for the fol-

lowing auditions in connection with which it is only necessary to change the disc records.

In the event that there is no current available or if for any other reasons it is desired to operate the clock mechanism, the clock mechanism is wound with the crank X (Fig. 1) and then the part O′ is pushed to the left and in this way the wedge O penetrates into the housing h of the bearing box A forcing the shaft E to rise due to the sliding of its lower end on the inclined plane shown in dotted line on Fig. 5 and at the same time the gear B disengages from the pinion P and the teeth of the sleeve F come into mesh with the teeth of the pulley V, connecting in this way the shaft E and imparting to it its rotation motion, which it receives from the pulley Z, through the transmission a″. This apparatus may be provided with its own governor, like those of its kind already known.

One could have used the gears in order to transmit the movement but a practical operation has shown that the best results are obtained by metal transmissions and belts consisting of a brass or steel wire, spirally connected, and with the ends united.

In talking machines which are designed in order to operate only on electric current, the wedges O, the pulley V, the sleeve F and the clock mechanism are eliminated.

If one desires to operate the apparatus with cells or storage batteries, the resistance lamp is replaced by a threaded plug which closes the circuit and does not constitute a resistance.

In the box of the machine and in a suitable place, there is provided a fuse which makes it possible to operate the apparatus without any risk.

In the second manner of execution shown in Fig. 6 and following figures, the electric mechanism consists of an electro-motor M (Fig. 6) with its rheostat

N, a centrifugal governor R, a resistance lamp L, a circuit closing device U with its fuse, and a switch rr. There is furthermore the column C which maintains the shaft E and which supports the turntable on which the disc records are placed. The motor M is similar to that described first; the rotary shaft is vertical and is attached (Translator's Note: ? to the turntable) at its upper end by means of a set screw, Fig. 10. It carries a double pulley P and Q, between the diameters of which there is an approximate ratio of 1:3. The centrifugal governor R, aside from the threaded rod T serving to increase or decrease the r. p. m., carries, attached to its upper part, another pulley R having a ratio of 1:2, with respect to the pulley P of the motor. The other elements or members are not described, as they are well known.

The mechanism for engaging or disengaging consists of the shaft (Fig. 7 and following figures) held by the column C and it carries two pulleys, the pulley S having a diameter which is approximately double that of the pulley P of the motor, held by the bent part of the said column C and that of V (½ of the former) held by the angular member D. These pulleys turn around the shaft E by their own weight. They are always in contact with the members supporting same. Attached to the shaft mentioned, by means of set screws s and s', two toothed rings on cylinders F and F' are arranged in the position shown on the said figures. The shaft E terminates at its lower part in a pivot penetrating the bearing A. The wedge O causes it, due to its inclined plane, to rise or to descend, depending on whether it is pushed inward or outward in its housing.

Below the pivot and above the wedge there is arranged a steel connecting rod to reduce the friction.

The arrangement of the rings F and F' is such that when the shaft is in its lowest position (Fig. 7)

the upper part is placed in mesh with the teeth g which carry the pulley S and the lower part is disengaged. On the contrary, when the shaft rises (Fig. 10) due to the thrust of the wedge in the bearing A, the lower ring comes into mesh with the pulley V and the upper ring releases S.

The clock mechanism is provided with the shaft H (the r. p. m. being suitable for the reproduction of disc records or other recorded discs) on which there is mounted the pulley Z, the diameter of which is equal to that of the pulley V mounted on the central column G of the apparatus.

In order to impart the motion, there are used metal transmissions constituted by brass or steel wire rolled in spiral and folded at the desired length, and which, due to its elasticity, facilitates the connecting of the pulleys while absorbing the sudden changes in speed which may be caused by the motor. The pulley P of the motor is coupled with the pulley R of the governor; the pulley Q of the motor is coupled with the pulley S of the shaft E and the pulley V is coupled with the gear Z of the clock mechanism Y.

The wedge O is pulled outward; in this manner the shaft E, by virtue of its own weight and of the weight of the turntable which it supports, goes down to its lowest position (Fig. 7) and engages the ring F' with the pulley S, while disengaging the wheel F from the pulley V, so that the shaft E remains connected with the pulley S and the pulley V is released.

This being done, the circuit is closed in the rheostat by means of the switch, the motor will start and drive (by means of transmission a') the pulley S of the shaft E and the turntable.

The motion is completely uniform because the governor is connected with the armature of the motor through the transmission and it regulates its rotation, which is precisely the essential basis of the entire

mechanism. As can be seen in Fig. 10, it increases or decreases the speed of rotation by simply turning in one direction or in the other the regulating rod T of the governor. As the pulley V, which is connected with the pulley Z of the clock mechanism by the transmission a″, is mounted idle around the shaft E, it remains at rest, like the mechanism. In order to stop momentarily or permanently the apparatus, it suffices to close the current in the rheostat or in the switch.

When it is desired to operate the apparatus by the clock mechanism, the wedge O is pushed inward, as shown in Fig. 10; the shaft F sliding on the inclined plane of the wedge rises, compelling the ring F to engage with the pulley V through its lower part and disengaging the pulley s which remains free. This being done, the clock mechanism is started, the shaft H and the pulley Z transmit, through the transmission a″, the movement of the pulley V and consequently to the shaft E and to the turntable, the pulley S and the electric motor remaining idle (free).

For the following reproductions, the mechanism is set at the point desired, by means of the threaded rod of the governor, which is independent from the electric driving mechanism. The apparatus may be manufactured to be exclusively operated by electric current. In this case the column C (Fig. 8) carries the shaft E with the pulley S held by a set screw E, thus eliminating everything that is connected with the clock mechanism, and the engaging and disengaging mechanism.

If in place of the disc records, there are used cylinder records or recorded films, the movement of the shaft E (Fig. 9) is transmitted to a secondary shaft E′, by means of a system of gears on which there are mounted the cylinders r and r′, between which there passes the film or the metallic mandrel in which there are placed the cylinders made of wax or any other recorded material.

CLAIMS.

The invention comprises the application of two forces, namely electric and mechanical (spring) forces for the operation of talking machines using disc records, cylinder records or films.

The electrically operated mechanical device by which the force of the armature of the motor is used for imparting a movement to the disc records, cylinder records, films or the like in talking machines, in combination with a mechanical governor.

Device for engaging and disengaging the operating mechanism.

Eduardo Lopez Martinez

By: De Bonge,
Agent.

(Translator's Note: The French of this patent is extremely poor, being obviously a poor verbatim translation from Spanish into French. I have therefore been compelled to make this translation as verbatim as possible.)

OFFICE NATIONAL DE LA PROPRIETE INDUSTRIELLE.

LIBRARY JUN 14 1916 U.S. PATENT OFFICE

BREVET D'INVENTION.

XII. — Instruments de précision, électricité.

2. — Appareils de physique et de chimie, optique, acoustique.

N° 472.467

Phonographe utilisant des bandes minces et flexibles comme support des phonogrammes.

Société DRAGOUMIS et LIORET résidant en France (Seine).

Demandé le 10 avril 1914, à 13 heures, à Paris.
Délivré le 6 août 1914. — Publié le 8 décembre 1914.
(Demande de brevet déposée en Belgique le 6 août 1913. — Déclaration des déposants.)

L'appareil faisant l'objet de cette invention est un phonographe permettant d'employer pour l'enregistrement et la reproduction des bandes sans fin minces et flexibles de différentes longueurs et de différentes largeurs, en celluloïd ou autre substance quelconque appropriée. Comme ces bandes peuvent défiler à une vitesse très réduite et peuvent être enregistrées des deux côtés, la longueur de l'enregistrement contenu sur une bande, même de dimensions restreintes, peut être très considérable.

Le dessin annexé, donné à titre d'exemple, représente une forme d'exécution de l'invention. A ce dessin :

Fig. 1 est une vue en plan.

Fig. 2, une vue de côté de l'appareil.

Fig. 3, la disposition pour le guidage des bandes.

1 est un tambour cylindrique d'un diamètre plus grand et d'une longueur plus petite que le tambour du phonographe ordinaire; son axe tourne dans le bâti 2.

3 est une perche articulée composée de deux ou de plusieurs parties. Cette perche passe dans un collier 4 et peut être rentrée ou sortie du bâti à volonté. La dernière partie 3' peut éventuellement être articulée sur une broche 5 que l'on engage dans un des trous 5 dont elle est pourvue. Ainsi, on peut employer des bandes de longueurs très différentes. Cette partie de la perche porte un rouleau 6 pivotant en 7, dont l'axe est une goupille qu'on peut retirer de la pièce 3'. Ce rouleau sert comme tendeur de la bande sans fin 8.

La disposition pour le guidage de la bande est composée d'une barre 10 fixée sur le socle de l'appareil, elle porte deux traverses 11 et 12. Le long de la traverse 12 glisse une joue mobile 13 qui peut être fixée par une vis de pression à une distance de la barre 10 égale à la largeur de la bande. Ainsi la bande 8 touche aux traverses arrondies 11 et 12 qui la maintiennent à plat et ne peut pas dévier maintenue entre 10 et 13.

Un indicateur montre les points où l'enregistrement ou le reproducteur touchent la bande. Cet indicateur est composé d'un tambour étroit 14 portant des divisions sur son pourtour. Les divisions de ce tambour qu'on tourne au moyen d'une manivelle 15 sont montrées par l'aiguille fixe 16. Un compteur 17 divisé de 0 à 9 marque le nombre des tours du tambour qui est engrené par des roues dentées avec la vis du chariot 18. Ainsi, quand le chariot se déplace, son déplacement est indiqué par l'indicateur, et on

peut ramener le chariot au point voulu en tournant la manivelle 15, le levier 19 sert à soulever l'enregistreur ou le reproducteur sans que le chariot cesse d'engrener avec la vis, ainsi est évité tout jeu résultant d'un enclenchement ou d'un déclenchement. La vis du chariot n'est pas solidaire de l'engrenage de réduction mais elle se laisse enclencher et déclencher sans aucun jeu au moyen des disques à friction 20. Quand ces disques ne se touchent pas, la vis est indépendante, quand par conséquent on ramène le chariot au point voulu en tournant la manivelle 15, le tambour 1 qui entraîne la bande 8 reste immobile. On peut ainsi pendant l'enregistrement ou pendant une reproduction, écrire une table de matières, comme pour un livre, où les numéros des pages seront remplacés par les numéros de l'indicateur. Cette table peut être en caractères en relief pour l'usage des aveugles dans ce cas les divisions de l'indicateur peuvent être aussi rendus sensibles au toucher.

21 est une butée quand le chariot touche à cette butée, l'indicateur 14 et le compteur de tours 17 doivent être à 0.

L'engrenage qui transmet le mouvement du tambour 1 à la vis du chariot peut être rendu interchangeable au moyen d'un dispositif connu. Ainsi on peut avoir par exemple deux ou trois rapports de réduction de tours correspondants à deux longueurs différentes de bandes. Mais si on a à employer des bandes d'un plus grand nombre de longueurs différentes, on peut employer les boîtes à engrenages décrites dans le brevet belge 245.606 du 16 avril 1912.

RÉSUMÉ.

L'invention concerne :

Un appareil phonographique permettant l'emploi des bandes sans fin minces et flexibles, de différentes longueurs et de différentes largeurs, comme support des phonogrammes, caractérisé par :

1° Une perche articulée dont la partie d'avant porte un rouleau tendeur et qui permet l'emploi de bandes de différentes longueurs;

2° Un guide pour les bandes comportant une joue fixe et une joue mobile qui empêchent la bande de dévier et deux traverses arrondies qui la maintiennent à plat, le guide permettant l'emploi de bandes de différentes largeurs;

3° Un indicateur de la position de l'enregistreur ou du reproducteur engrenant avec la vis du chariot, et qui peut ramener le chariot au point voulu.

SOCIÉTÉ DRAGOUMIS ET LIORET.

Par procuration :

G. PETIET.

N° 472.467 Societe Dragoumis et Lioret Pl. unique

Fig. 1.

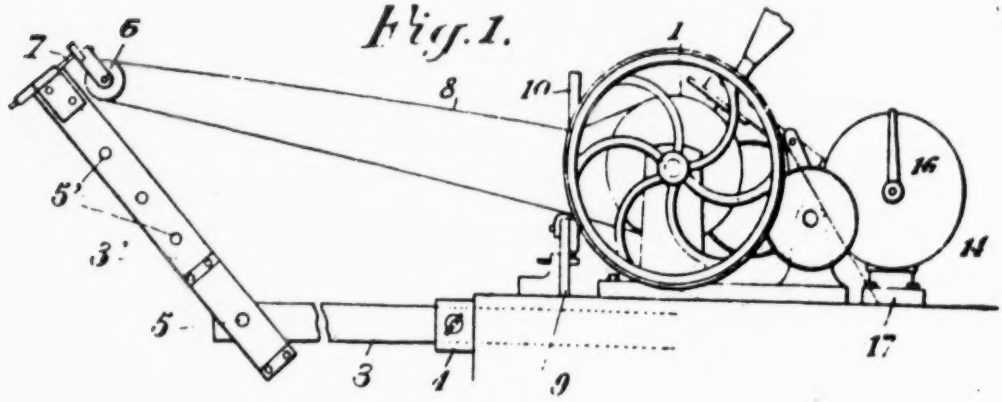


Fig. 2.

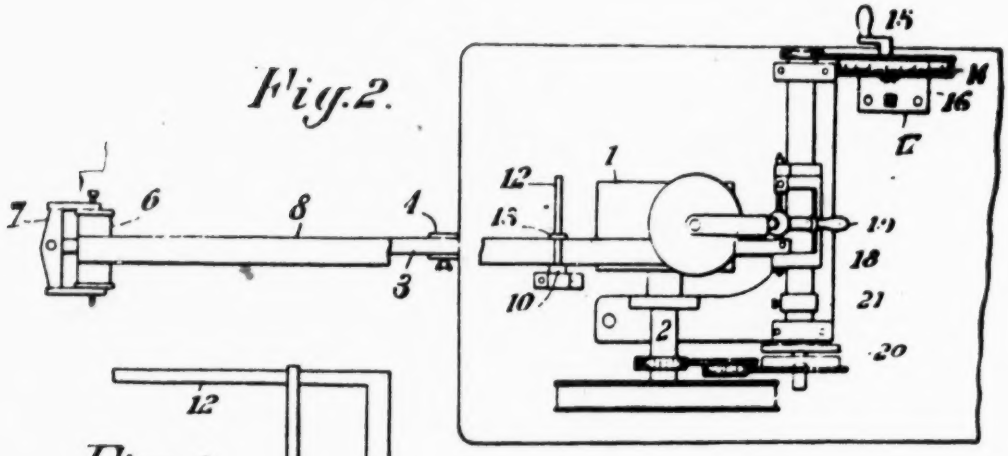
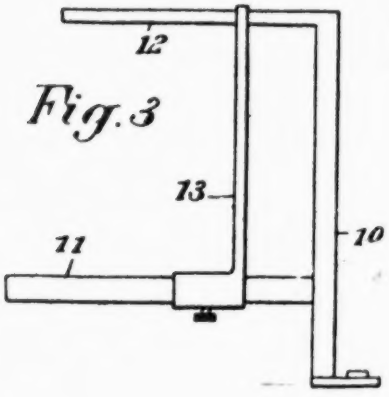


Fig. 3



Translation.

French Republic.

French Patent and Trademark Office
PATENT OF INVENTION.

No. 472,467

XII.—Precision Instruments—Electricity.

2.—Apparatus for physics, chemistry, optics, acoustics.

Phonograph utilizing thin and flexible films as phonogram carriers.

Societe DRAGOUMIS & LIORET residing in France (Seine).

Patent applied for on April 10, 1914, at 1:00 P. M. in Paris.

Issued on August 6, 1914—Published on Dec. 8, 1914.

(Patent application filed in Belgium on Aug. 6, 1913.—Declaration of the applicants.)

The apparatus which is the subject matter of this invention is a phonograph making it possible to use, for recording and reproduction, endless, thin and flexible films of various lengths and different widths, of celluloid or any other suitable substance. As these films can run at a very reduced speed and can receive recordings on both sides, the length of recording contained on one band, even of reduced dimensions, can be very considerable.

The attached drawing, given by way of example, shows a manner of execution of the invention. In this drawing:

Fig. 1 is a plan view.

Fig. 2 is a side view of the apparatus.

Fig. 3 is the arrangement for the guiding of the films.

1 is a cylindrical drum of a diameter which is larger and of a length which is smaller than the drum of an ordinary phonograph. Its shaft rotates in the frame 2.

3 is an articulated rod made of two or more parts. This rod passes through a collar 4 and can be pushed in or out of the frame at will. The last part 3′ can possibly be articulated to a spindle 5 which is engaged in one of the holes 5 with which it is provided. In this connection one can use films of greatly different lengths. This part of the rod carries a roller 6 which pivots at 7, the shaft of which is a pin which may be drawn out of the part 3′. This roller serves as a tensioning member of the endless film 8.

The device for the guiding of the film consists of a bar 10 arranged on the base of the apparatus. It is provided with two cross members 11 and 12. Along the cross member 12 there slides a movable flange 13 which can be fixed by a set screw at a distance from the bar 10 equal to the width of the film. Thus the film 8 touches the rounded cross members 11 and 12 which hold it flat and thus it cannot deviate as it is held between 10 and 13.

An indicator shows the points where the recording or the reproducing member touches the film. This indicator is composed of a narrow drum 14 carrying graduations along its periphery. Graduations of this drum which is rotated by means of a crank 15 are shown by the fixed needle 16. A meter 17 which is graduated from zero to 9, shows the number of ~~R.P.M.~~ revolutions of the drum which is placed in mesh, by means of sprocket wheels, with the screw of the carriage 18. Thus, when the carriage moves, its displacement is shown by the indicator and the carriage may be brought back to the desired point by turning the crank 15; the lever 19 serves to raise the recorder or the reproducer without the carriage ceasing to be in mesh with the screw; thus there

is avoided any play resulting from a getting in or getting out of mesh. The screw of the carriage is not integral with the reduction gear but it gets into and out of mesh without any play by means of friction discs 20. When these discs do not touch one another, the screw is independent. When consequently the carriage is brought back to the desired point by turning the crank 15, the drum 1 which carries along the film 8, remains stationary. Thus, during the recording or during the reproduction, it is possible to write up an index as for a book, in which the numbers of the pages are replaced by the numbers of the indicator. This table may be in relief type (characters) for the use of the blind, and in this case the graduations of the indicator may be also made sensitive to touch.

21 is a thrust bearing. When the carriage touches this bearing, the indicator 14 and the speedometer 17 (R. P. M. indicator) must be at zero.

The gear which transmits the movement from the drum 1 to the screw of the carriage may be made interchangeable by means of a known device. Thus, for instance, one can have two or three reduction ratios of the revolutions corresponding to two different lengths of the films. But, if one has to use films of a large number of different lengths, one can use the gear boxes described in the Belgian patent 245,606, of April 16, 1912.

CLAIMS:

The invention covers:

A phonograph apparatus making possible the use of endless, thin and flexible films of different lengths and different widths, as phonogram carriers, characterized by:

1. An articulated rod, the front part of which is provided with a tensioning roller which makes possible the use of films of different lengths;

2. A guide for the films comprising a fixed flange and a movable flange which prevent the film from deviating and two rounded cross members holding it flat, the guide making it possible to use films of different widths;

3. A position indicator of the recording device or of the reproducing device engaging with the screw of the carriage and which can return the carriage to the desired point.

SOCIETE DRAGOUMIS et LIORET.

By: G. Petiac, Agent.

Max Aftergut in Berlin-Schlachtensee.

Verfahren und Vorrichtung zur Erzeugung von Schallkurven.

Patentiert im Deutschen Reiche vom 8. September 1921 ab.

Die Erfindung bezieht sich auf ein Verfahren zur Erzeugung von Schallkurven für die Tonwiedergabe auf Grund von Kurven, welche von einem Schallstift auf ein fortlaufend bewegtes Band aufgezeichnet werden. Die Erfindung bezweckt die Erzeugung von Schallkurven, welche eine sehr starke Tonwiedergabe ermöglichen und auch bei häufiger Benutzung keine wesentliche Abnutzung aufweisen. Der Erfindungszweck wird dadurch erreicht, daß die auf dem fortlaufend bewegten Band unter dem Einfluß der Membranschwingungen aufgezeichnete Kurve unter fortschreitender Bewegung ihres Trägers fortlaufend vergrößert auf einen Schirm projiziert wird, und daß das dabei entstehende Kurvenlichtbild unmittelbar als Leitkurve zur Steuerung eines Werkzeuges benutzt wird, welches ein Abbild der Kurve in den Rand eines fortschreitend bewegten Bandes als Schallwiedergabekurve einschneidet.

Bei dieser Anordnung wird der schwingenden Membran ein Mindestmaß an Arbeit zugemutet, da sie nur eine Kurve zu zeichnen braucht. Die Vergrößerung der Kurve durch Projektion bietet die Möglichkeit, ein Werkzeug sehr genau entsprechend den Windungen der Kurve zu führen und zugleich die weitere Möglichkeit, diese Führung unter Anwendung beliebig starker Kräfte vorzunehmen und auch das Werkzeug mit beliebig großer Kraft anzutreiben. Dadurch wird einerseits eine große Genauigkeit in der Wiedergabe der Kurve ermöglicht und anderseits die Anwendung eines harten und billigen Materials, wie z. B. Metall, als Träger der für die Reproduktion bestimmten Schallkurve. Die Benutzung des durch Projektion gewonnenen vergrößerten Lichtbildes der [illegible] stellung von körperlichen vergrößerten Schallwiedergabekurven zur Steuerung des Werkzeugs fortfällt.

Die Schallaufnahmekurve kann im besonderen auf demselben Bande aufgezeichnet werden, in dessen Rand man die Schallwiedergabekurve einschneidet. Das kommt besonders in Betracht, wenn es sich darum handelt, einen kombinierten Bild- und Sprechfilm zu erzeugen. Man kann in diesem Falle bei der kinematographischen Aufnahme in bekannter Weise zugleich an dem Rande des Bildfilms eine Schallkurve aufzeichnen lassen und diese darauf unter Zwischenschaltung einer Projektion in größerem Maßstabe unter Benutzung einer geeigneten Apparatur in den Rand des Bildfilms einschneiden, so daß der Film die Möglichkeit bietet, bei der Wiedergabe zu gleicher Zeit das Bild und den Ton wiederzugeben.

Eine Einrichtung, die die Erfindung verwirklicht, ist auf der Zeichnung im wesentlichen schematisch dargestellt.

Abb. 1 veranschaulicht die Herstellung der Schallaufnahmekurve.

Abb. 2 zeigt die Benutzung der Schallaufnahmekurve zur Erzeugung einer vergrößerten Projektion und die Benutzung der letzteren als Leitkurve beim Einschneiden der Schallwiedergabekurve in den Rand des Bildbandes.

Abb. 3 veranschaulicht die Benutzung des an seinem Rande eine Schallwiedergabekurve aufweisenden Bildbandes für die Lautwiedergabe.

In Abb. 1 bezeichnet 1 eine Schalldose mit Schalltrichter 2 und Nadelarm 3. 4 ist ein an der Schalldose sitzender Ansatz zur festen Verbindung der Schalldose und des Schalltrichters

2. A guide for the films comprising a fixed flange and a movable flange which prevent the film from deviating and two rounded cross members holding it flat, the guide making it possible to use films of different widths;

3. A position indicator of the recording device or of the reproducing device engaging with the screw of the carriage and which can return the carriage to the desired point.

SOCIETE DRAGOUMIS et LIORET.

By: G. Petiac, Agent.

Max Aftergut in Berlin-Schlachtensee.

Verfahren und Verrichtung zur Erzeugung von Schallkurven.

Patentiert im Deutschen Reiche vom 8. September 1921 ab.

Die Erfindung bezieht sich auf ein Verfahren zur Erzeugung von Schallkurven für die Tonwiedergabe auf Grund von Kurven, welche von einem Schallstift auf ein fortlaufend bewegtes Band aufgezeichnet werden. Die Erfindung bezweckt die Erzeugung von Schallkurven, welche eine sehr starke Tonwiedergabe ermöglichen und auch bei häufiger Benutzung keine wesentliche Abnutzung aufweisen. Der Erfindungszweck wird dadurch erreicht, daß die auf dem fortlaufend bewegten Band unter dem Einfluß der Membranschwingungen aufgezeichnete Kurve unter fortschreitender Bewegung ihres Trägers fortlaufend vergrößert auf einen Schirm projiziert wird, und daß das dabei entstehende Kurvenlichtbild unmittelbar als Leitkurve zur Steuerung eines Werkzeuges benutzt wird, welches ein Abbild der Kurve in den Rand eines fortschreitend bewegten Bandes als Schallwiedergabekurve einschneidet.

Bei dieser Anordnung wird der schwingenden Membran ein Mindestmaß an Arbeit zugemutet, da sie nur eine Kurve zu zeichnen braucht. Die Vergrößerung der Kurve durch Projektion bietet die Möglichkeit, ein Werkzeug sehr genau entsprechend den Windungen der Kurve zu führen und zugleich die weitere Möglichkeit, diese Führung unter Anwendung beliebig starker Kräfte vorzunehmen und auch das Werkzeug mit beliebig großer Kraft anzutreiben. Dadurch wird einerseits eine große Genauigkeit in der Wiedergabe der Kurve ermöglicht und anderseits die Anwendung eines harten und billigen Materials, wie z. B. Metall, als Träger der für die Reproduktion bestimmten Schallkurve. Die Benutzung des durch Projektion gewonnenen vergrößerten Lichtbildes der ursprünglichen Aufnahmekurve unmittelbar zur Steuerung des Werkzeugs macht die Apparatur außerordentlich einfach, da die Notwendigkeit der Herstellung von körperlichen vergrößerten Schallwiedergabekurven zur Steuerung des Werkzeugs fortfällt.

Die Schallaufnahmekurve kann im besonderen auf demselben Bande aufgezeichnet werden, in dessen Rand man die Schallwiedergabekurve einschneidet. Das kommt besonders in Betracht, wenn es sich darum handelt, einen kombinierten Bild- und Sprechfilm zu erzeugen. Man kann in diesem Falle bei der kinematographischen Aufnahme in bekannter Weise zugleich an dem Rande des Bildfilms eine Schallkurve aufzeichnen lassen und diese darauf unter Zwischenschaltung einer Projektion in größerem Maßstabe unter Benutzung einer geeigneten Apparatur in den Rand des Bildfilms einschneiden, so daß der Film die Möglichkeit bietet, bei der Wiedergabe zu gleicher Zeit das Bild und den Ton wiederzugeben.

Eine Einrichtung, die die Erfindung verwirklicht, ist auf der Zeichnung im wesentlichen schematisch dargestellt.

Abb. 1 veranschaulicht die Herstellung der Schallaufnahmekurve.

Abb. 2 zeigt die Benutzung der Schallaufnahmekurve zur Erzeugung einer vergrößerten Projektion und die Benutzung der letzteren als Leitkurve beim Einschneiden der Schallwiedergabekurve in den Rand des Bildbandes.

Abb. 3 veranschaulicht die Benutzung des an seinem Rande eine Schallwiedergabekurve aufweisenden Bildbandes für die Lautwiedergabe.

In Abb. 1 bezeichnet 1 eine Schalldose mit Schalltrichter 2 und Nadelarm 3. 4 ist ein an der Schalldose sitzender Ansatz zur festen Verbindung der Schalldose und des Schalltrichters mit einem Gehäuse. 5 ist die Schallmembran und 6 die Nadel zur Aufzeichnung der Schallkurve. 7 bezeichnet einen Bildfilm, auf dessen Rand die Schallkurve aufgezeichnet werden soll.

welche bei 8 angedeutet ist. Die Aufzeichnung der Schallkurve erfolgt gleichzeitig mit der Beleuchtung des Filmes. Da die Bildaufnahme nicht zum Wesen der Erfindung gehört, sind die Mittel zu ihrer Herbeiführung auf der Zeichnung nicht angedeutet. Die Zeichnung veranschaulicht vielmehr nur ein Stück eines üblichen Filmes.

Der auf die beschriebene Weise mit einer Schallaufnahmekurve 8 versehene Film 7 wird in die aus Abb. 2 ersichtliche Apparatur eingesetzt, welche mit Hilfe der Projektionseinrichtung 9 gestattet, die Schallaufnahmekurve 8 in vergrößertem Maßstabe als Leitkurve 10 für ein Arbeitswerkzeug auf einen Schirm 11 zu projizieren. Nach der Darstellung der Zeichnung besteht das Arbeitswerkzeug aus einer kleinen Fräserscheibe 12, welche auf das freie Ende 13 der Welle eines Elektromotors 14 aufgesetzt ist, der einen Teil eines schwingbar in einer Gabel 15 gelagerten Hebels bildet, dessen freies Ende 16 entlang der Leitkurve 10 geführt wird, während diese uber den Schirm 11 hinwandert, wenn das Bildband 7 langsam bewegt wird. Die Fräserscheibe 12 legt sich gegen den Rand des Bildbandes 7 und schneidet in diesen eine Kurve ein, wenn das Bildband bewegt wird und dabei die Hebelspitze 16 über die Leitkurve 10 geführt wird.

Das Resultat dieser Operation ist ein Bildband mit eine Schallwiedergabekurve darstellendem, profiliertem Rand 17.

Wenn das Bildband in einen Projektionsapparat eingesetzt wird und wenn gleichzeitig der Schallstift eines Schallwiedergabeapparates in Eingriff mit der Schallwiedergabekurve 17 gebracht wird, dann erfolgt zugleich mit der Projektion der Bilder des Filmes eine Reproduktion der bei der Bildaufnahme gemachten Schallaufnahme. Abb. 3 zeigt schematisch die Anordnung der Schallwiedergabevorrichtung in Verbindung mit dem Bildfilm. Der letztere ist wieder mit 7, die die Schallwiedergabekurve darstellende Kante des Filmes mit 17 bezeichnet. 18 ist die Fassung einer Schallmembran 19. 20 ein Schalltrichter und 21 ein am Membrangehäuse sitzender Ansatz, mittels dessen das Membrangehäuse 18 nebst Trichter 20 an einem Träger befestigt ist. 22 ist ein zentral an der Membran 19 befestigter, bei 23 in üblicher Weise schwingend gelagerter Arm, welcher einen Wiedergabestift 24 trägt, der an seinem Ende flach ausläuft und mit diesem sich gegen die Schallwiedergabekurve 17 legt, welche in den Rand des Filmes 7 eingeschnitten ist. Während der Film abrollt, bewegt sich die Schallwiedergabekurve 17 am Stift 24 des Schallwiedergabeapparates und drückt der Membran 19 Schwingungen auf, welche als Schall in den Raum hinausgehen.

Obwohl nach der Darstellung der Zeichnung die Erfindung in Verbindung mit einem Bildfilm dargestellt ist, ist diese Verbindung doch in keiner Weise notwendig. Man kann vielmehr für die Aufnahme auch ein gewöhnliches durchsichtiges Band benutzen und auf dieses die Schallkurve aufzeichnen. Die Reproduktion in Form einer vergrößerten Leitkurve erfolgt dann in der gleichen Weise wie vorstehend beschrieben und ebenso auch die Umsetzung der Leitkurve in die Schallwiedergabekurve. Als Material für diese kann, wenn es sich nur um ein einfaches Lautband handelt, beispielsweise auch ein Metallstreifen benutzt werden.

Patent-Ansprüche:

1. Verfahren zur Erzeugung von Schallkurven für die Tonwiedergabe auf Grund von Kurven, welche auf ein fortlaufend bewegtes Band aufgezeichnet werden, dadurch gekennzeichnet, daß man die Schallaufnahmekurve unter fortschreitender Bewegung ihres Trägers fortlaufend vergrößert auf einen Schirm projiziert und hierauf das projizierte Lichtbild der Kurve unmittelbar als Lichtkurve zur Steuerung eines Werkzeugs benutzt, welches ein Abbild der Kurve in den Rand eines fortschreitend bewegten Bandes als Schallwiedergabekurve einschneidet.

2. Verfahren nach Anspruch 1, bei welchem die Schallkurve auf den Rand eines Bildfilms bei Belichtung des letzteren aufgezeichnet wird, dadurch gekennzeichnet, daß das die Schallkurve auf Grund einer vergrößerten Projektion derselben reproduzierende Werkzeug die Wiedergabekurve in den Rand des gleichen Bildfilms eingräbt.

3. Vorrichtung zur Ausführung des Verfahrens nach Anspruch 1 und 2, dadurch gekennzeichnet, daß das die Schallwiedergabekurve in den Rand des fortschreitend bewegten Bandes einschneidende Werkzeug aus einem schwingbar gelagerten Hebel besteht, welcher mit seinem einen Ende entlang der daran vorbei wandernden projizierten Lichtkurve (10) geführt wird, während sein anderes Ende das rotierende Schneidwerkzeug (12) trägt.

4. Vorrichtung nach Anspruch 3, dadurch gekennzeichnet, daß der schwingbar gelagerte Hebel einen Elektromotor (14), dessen Welle die Fräserscheibe (12) trägt, einschließt und in einer Gabel (15) gelagert ist.

Hierzu 1 Blatt Zeichnungen.

E. [illegible] GEDRUCKT IN DER REICHSDRUCKEREI.

Abb. 1.

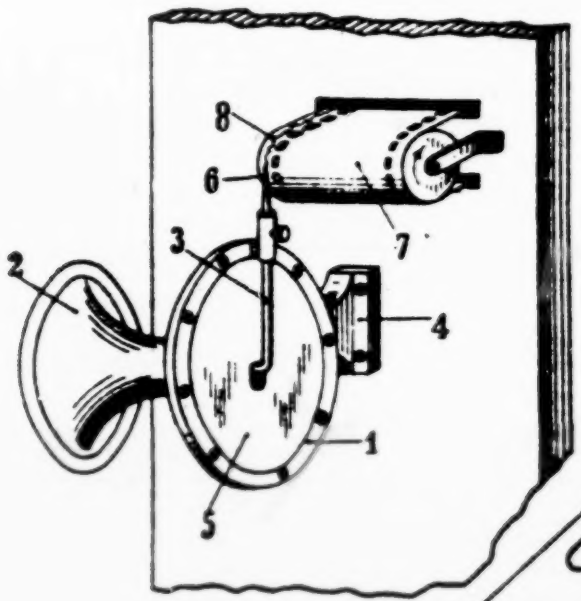


Abb. 2.

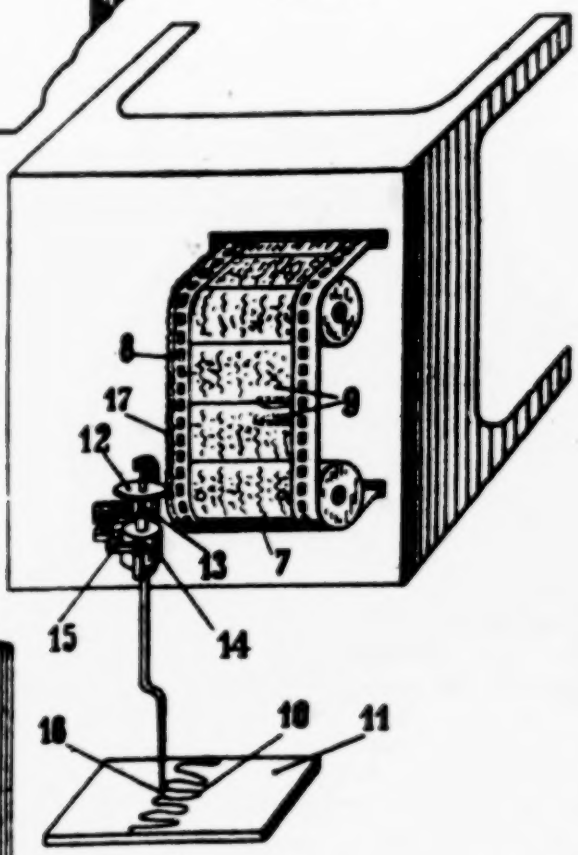
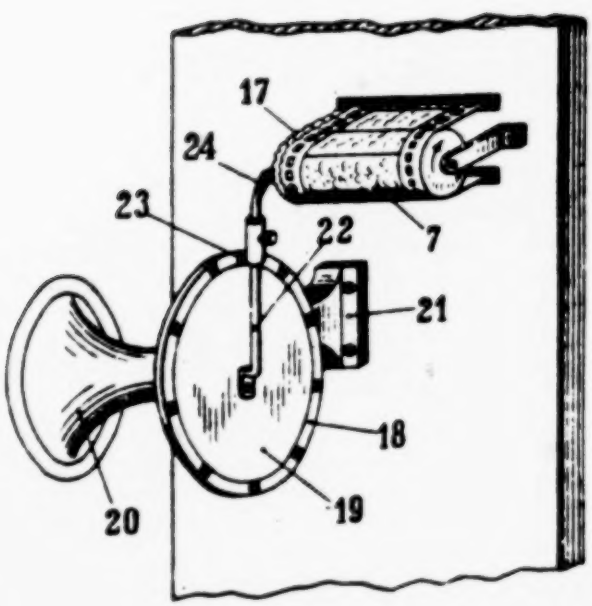


Abb. 3.



Translation.

GERMAN PATENT 363640

Class 42g, Group 17

Max Aftergut, of Berlin-Schlachtensee.
Process and device for the production of sound-curves.

Patented in Germany from September 8, 1921.

The invention relates to a process for the production of sound-curves for reproduction of tones on the basis of curves which are recorded by a sound-needle upon a continuously moved strip. The invention aims at the production of sound-curves which render possible a very powerful tone-reproduction and which manifest no material wear even in case of frequent use. The purpose of the invention is attained by this means, that the curve that is recorded upon the continuously moved strip under the influence of the membrane vibrations is continuously projected upon a screen in magnified form with concomitant progressive movement of its carrier, and that the curve light-image that is produced in this connection is used directly as a guide curve for the guidance of a tool which cuts a likeness of the curve into the edge of a progressively moved strip as a curve for reproduction of sound.

In this arrangement a minimum of work is required of the vibrating membrane, since it need merely draw a curve. The magnifying of the curve by projection affords the possibility of guiding a tool in very accurate conformity with the sinuosities of the curve, and at the same time the further possibility of undertaking this guidance with the employment of forces of any desired power and also of driving the tool with as

great power as desired. In consequence thereof there is rendered possible, on the one hand, great accuracy in the reproduction of the curve and, on the other hand, the employment of a hard and cheap material, such as metal, for example, as carrier of the sound-curve intended for the reproduction. The use of the magnified light-image, obtained by projection, of the original record curve directly for the guidance of the tool makes the apparatus extremely simple, since the necessity of the production of physical magnified sound-reproduction curves for guidance of the tool is dispensed with.

The sound-record curve may, in particular, be recorded on the same strip into the edge of which the sound-reproduction curve is cut. This comes into consideration particularly if the problem is that of producing a combined picture film and talking film. In that case it is possible to have a sound-curve recorded on the margin of the picture in well-known fashion simultaneously at the time of the cinematographic exposure and thereupon to cut this curve into the edge of the picture film on a larger scale with the use of a suitable apparatus, with interposition of a projection, so that the film affords the possibility of reproducing the picture and the tone simultaneously at the time of the reproduction.

An arrangement which actualizes the invention is represented in the drawing, essentially in diagram form.

Fig. 1 shows the production of a sound-record curve.

Fig. 2 shows the employment of the sound-record curve for the production of a magnified projection, and the employment of the latter as a guide-curve at the cutting of the sound-reproduction curve into the edge of the picture film.

Fig. 3 shows the employment, for the sound-reproduction, of the picture strip which has a sound-reproduction curve on its edge.

In Fig. 1, 1 designates a sound-box with a sound-horn 2 and a needle arm 3. 4 is a shoulder located on the sound-box for the purpose of firm attachment of the sound-box and the sound-horn to a casing. 5 is the sound-membrane and 6 is the needle for the recording of the sound-curve. 7 designates a picture film upon the margin of which there is to be recorded the sound-curve, which is indicated at 8. The recording of the sound-curve takes place simultaneously with the exposure of the film. Since the taking of the picture does not belong to the essence of the invention, the means of bringing it about are not indicated on the drawing. On the contrary, the drawing illustrates only a portion of an ordinary film.

The film 7, which has been provided in the manner described with a sound-record curve 8, is inserted in the apparatus that is apparent from Fig. 2, which apparatus renders it possible, with the aid of the projection arrangement 9, to project the sound-record curve 8 upon a screen 11 on an enlarged scale as a guide-curve 10 for an operating tool. According to the representation in the drawing, the operating tool consists of a small milling cutter disk 12 which is set upon the free end 13 of the shaft of an electric motor 14 which forms a part of a lever which is pivoted in a fork 15 so that it is able to swing and whose free end 16 is guided along the guide-curve 10, while the latter travels across the screen 11 when the picture strip 7 is slowly moved. The milling cutter disk 12 applies against the edge of the picture strip and cuts a curve into the latter when the picture strip is moved and the point 16 of the lever is concurrently guided over the guide-curve 10.

The result of this operation is a picture strip with a profiled edge 17 which represents a curve for reproduction of sound.

If the picture strip is inserted in a projection apparatus and if at the same time the sound-needle of a sound-reproduction apparatus is brought into engagement with the sound-reproduction curve 17, then there takes place, simultaneously with the projection of the pictures of the film, a reproduction of the sound-record that was made at the time of the photographing of the picture. Fig. 3 shows in diagram form the arrangement of the sound-reproduction device in connection with the picture film. The latter is again designated by 7, and the edge of the film that represents the sound-reproduction curve is designated by 17. 18 is the frame of a sound-membrane 19, 20 is a sound-horn, and 21 a shoulder located on the membrane casing, by means of which shoulder the membrane casing 18 with the horn 20 is attached to a support. 22 is an arm which is centrally attached to the membrane 19 and is pivoted at 23 in the customary manner so as to swing, and which carries a reproduction needle 24 which has a flat tip at its end and applies with the latter against the sound-reproduction curve 17 which is cut into the edge of the film 7. While the film is unrolling, the sound-reproduction curve 17 moves at the needle 24 of the sound-reproduction apparatus and imparts to the membrane 19 vibrations which pass out into the room as sound.

Although, according to the representation in the drawing, the invention is shown in connection with a picture film, this connection is nevertheless by no means necessary. On the contrary, one may also use for the recording an ordinary transparent strip and record the sound-curve upon this strip. The reproduction in the form of a magnified guide-curve then takes place in the

same manner as described above, and likewise also the conversion of the guide-curve into the sound-reproduction curve. As material for the latter, if only a simple sound-strip is involved, a metal strip, for example, may also be used.

PATENT CLAIMS.

1. Process for the production of sound-curves for reproduction of tones on the basis of curves which are recorded upon a continuously moved strip, characterized by the fact that the sound-record curve is continuously projected upon a screen in magnified form with concomitant progressive movement of its carrier and that the projected light-image of the curve is thereupon used directly as a light-curve for the guidance of a tool which cuts a likeness of the curve into the edge of a progressively moved strip as a curve for reproduction of sound.

2. Process in accordance with claim 1, in which the sound-curve is recorded upon the margin of a picture film at the time of the exposure of the latter, characterized by the fact that the tool which reproduces the sound-curve on the basis of a magnified projection thereof engraves the reproduction-curve upon the margin of the same picture film.

3. Device for carrying out the process in accordance with claims 1 and 2, characterized by the fact that the tool which cuts the sound-reproduction curve into the edge of the continuously moved strip consists of a lever which is pivoted so as to be able to swing and which is guided with one of its ends along the projected light-curve (10) which travels past it, while the other end thereof carries the rotating cutting tool (12).

4. Device in accordance with claim 3, characterized by the fact that the lever which is pivoted so as to be able to swing includes an electric motor (14) whose shaft carries the milling cutter disk (12) and is pivoted in a fork (15).

SCHWEIZERISCHE EIDGENOSSENSCHAFT

EIDGEN. AMT FÜR GEISTIGES EIGENTUM

PATENTSCHRIFT

Veröffentlicht am 16. November 1920

Nr. 85751 (Gesuch eingereicht: 11. Oktober 1919, 6 Uhr p.) Klasse 69

HAUPTPATENT

Dr. Eugen ALBER, Basel (Schweiz).

Sprechmaschine mit bandförmigem Phonogrammträger.

Gegenstand vorliegender Erfindung ist eine Sprechmaschine, bei welcher ein Mechanismus ein mit parallel nebeneinander liegenden Schallfurchen versehenes Schallband, welches an seinen beiden Enden offen, d. h. nicht in sich selbst geschlossen ist, an einer Schalldose vorbeibewegt und welche dadurch gekennzeichnet ist, daß der Schall sowohl bei der Vor- als auch bei der Rückwärtsbewegung des Bandes mit Hilfe eines Stiftes auf ein- und dieselbe Membran übertragen wird.

Im Nachstehenden und auf beiliegender Zeichnung ist der Erfindungsgegenstand in Fig. 1 in schematischer Darstellung an einem Ausführungsbeispiel dargestellt; Fig. 2 ist eine Ansicht eines Ausführungsbeispiels des Schallbandes.

Es soll 1 einen Mechanismus darstellen, welcher die Transportwalze 2 je nach Wunsch im Sinne des Uhrzeigers oder im entgegengesetzten Sinne bewegen kann. Auf der Zeichnung wird durch diese Walze das Band 3 von der Trommel *B* abgewickelt, an dem, in den Schallfurchen gleitenden Membranstifte 4 der Schalldose 5 vorübergezogen und auf der Trommel *A* aufgewickelt. Schalltrichter, Schallverstärker und dergleichen sind der Einfachheit wegen weggelassen worden. Die beiden Rollen 6 drücken das Schallband an die Walze 2 an. Das Schallband ist parallel seiner Länge mit den Schallfurchen a_1—e_1, a_2—e_2, a_3—e_3 etc. versehen, welche auf dem Bande so angeordnet sind, daß die Anfänge und Enden der Schallfurchen abwechselnd nebeneinander liegen und je das Ende einer Schallfurche und der Anfang der nächstfolgenden in eine gemeinsame Furche zusammenlaufen, in welcher der Schallabnahmestift während des Umschaltens der Bewegungsrichtung des Bandes gleitet und welche dazu dient, den Schallabnahmestift vom Ende einer soeben durchlaufenen Schallfurche in den Anfang der nächstfolgenden zu führen. In Fig. 2 bedeuten a_1, a_2, a_3 etc. die Anfänge und e_1, e_2, e_3 etc. die Enden der Schallfurchen; g_1, g_2, g_3 etc. sind die gemeinsamen Furchen. S_1 repräsentiert die Stellung des im Endstück e_1 gleitenden Schallabnahmestiftes nach erfolgter Reproduktion des ersten Vortragsstückes, wobei das Schallband in der Richtung des daneben

liegenden Pfeils sich bewegt: in der Stellung δ_m, d. h. also in der gemeinsamen Furche g_1 befindet sich der Stift nach erfolgter Arretierung der Bandbewegung. Wird nun der Mechanismus eingeschaltet, und dadurch das Band rückwärts bewegt im Sinne des bei a_2 markierten Pfeils, dann gleitet der Anfang a_2 der nächstfolgenden Schallfurche unter den Membranstift (Stellung δ_m), vorausgesetzt, daß dieser in der zu der Zeichenebene liegenden Richtung senkrecht zur Linie a_2 etwas gedrückt oder gezogen wird, beispielsweise unter dem Einfluß einer auf die Schalldose einwirkenden Feder oder eines Gewichtes, wodurch der Membranstift an denjenigen Rand der gemeinsamen Furche g_1 angepreßt wird, welchen diese mit a_2 (und nicht mit a_1) gemeinsam hat. Das Umschalten von Vor- auf Rückwärtslauf des Bandes geschieht automatisch.

Der Mechanismus kann durch ein Federtriebwerk, durch einen Elektromotor oder irgend eine andere mechanische Kraft in Bewegung gehalten werden. Im vorliegenden Beispiele ist eine Phonographenschalldose skizziert, für andere Schallschriften wird natürlich eine entsprechende Schalldose verwendet.

Für Schallbänder, welche mehrere Schallfurchensysteme aufweisen, welche gleichzeitig gespielt werden und zu einem Vortragsstücke sich ergänzen, ist eine der Anzahl der Schallfurchensysteme entsprechende Anzahl von Schallabnahmestiften vorgesehen.

Die vorliegende Sprechmaschine kann auch so ausgeführt werden, daß sie gleichzeitig mit einem Schallband auch einen Lichtbilderfilm fortbewegt. In Fig. 1 wird zu diesem Zwecke, z. B. auch die Achse der Transportrolle 2 auch eine Transportrolle für den Lichtbilderfilm montiert. Die Radien dieser Transportrollen verhalten sich zueinander wie die dazugehörigen Filmgeschwindigkeiten. Die beiden Transportrollen können auch auf verschiedenen, voneinander getrennten Achsen montiert sein, wenn diese in einem solchen Übersetzungsverhältnis miteinander gekuppelt sind, daß die Transportrollen und damit die beiden Filme die erforderliche Geschwindigkeit erhalten. Ein Außergangfallen der beiden Filme ist damit ausgeschlossen. Der Antrieb und die Regulierung der Geschwindigkeit besorgt stets der Sprechmaschinenmechanismus. Mit Hilfe zweier synchron sich drehender Achsen läßt sich auch der Mechanismus des Kinematographen ganz abtrennen von der Sprechmaschine und beliebig weit von dieser aufstellen, wenn die eine von den synchronlaufenden Achsen das Transportrad des Lichtfilms, die andere dasjenige des Schallfilms unter Einschaltung einer Geschwindigkeitsübersetzung bewegt.

PATENTANSPRUCH:

Sprechmaschine, bei welcher ein Mechanismus ein mit parallel nebeneinander liegenden Schallfurchen versehenes, offenes Schallband an einer Schalldose vorbeibewegt, dadurch gekennzeichnet, daß der Schall sowohl bei der Vor- als auch bei der Rückwärtsbewegung des Bandes mit Hilfe eines Stiftes auf ein und dieselbe Membran übertragen wird.

UNTERANSPRÜCHE:

1. Sprechmaschine nach Patentanspruch, dadurch gekennzeichnet, daß das Umschalten von Vor- auf Rückwärtslauf des Schallbandes automatisch geschieht.
2. Sprechmaschine nach Patentanspruch, bei welcher je das Ende der einen Schallfurche des Schallbandes und der Anfang der daneben liegenden Schallfurche in eine gemeinsame Furche zusammenlaufen, dadurch gekennzeichnet, daß der Schallabnahmestift im Momente des Wechsels der Schallbandbewegungsrichtung an denjenigen Rand der gemeinsamen Furche angedrückt wird, welchen diese letztere mit der nächstfolgenden Schallfurche gemeinsam hat.
3. Sprechmaschine nach Patentanspruch, dadurch gekennzeichnet, daß der Mechanismus mit einem Schallbande gleichzeitig auch einen Lichtfilm bewegt.
4. Sprechmaschine nach Patentanspruch, dadurch gekennzeichnet, daß die Achse der

857 51

Schallbandtransportrolle gleichzeitig mit dem Schallband auch einen Lichtfilm bewegt.

5. Sprechmaschine nach Patentanspruch und Unteranspruch 3, dadurch gekennzeichnet, daß die Transportrollen von Schall- und Lichtfilm auf getrennten, jedoch miteinander gekuppelten Achsen angeordnet sind.

6. Sprechmaschine nach Patentanspruch und Unteranspruch 5, dadurch gekennzeichnet, daß die Transportrollen von Schallband und Lichtfilm unter Zwischenschaltung von synchronlaufenden Achsen miteinander gekuppelt sind.

Dr. Eugen ALBER.

222

Dr. Eugen Alber

Patent Nr. 85751
1 Blatt

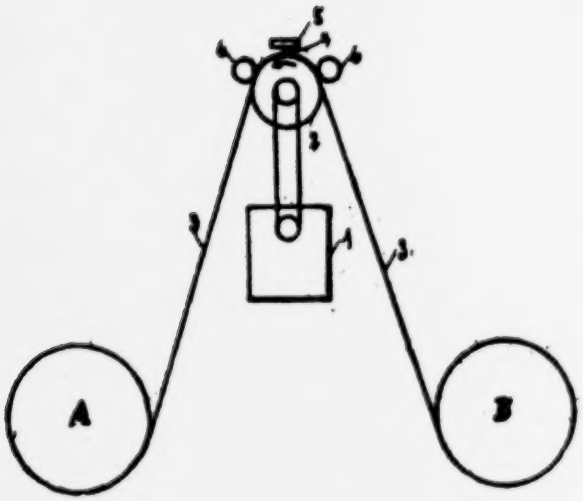


Fig. 1.

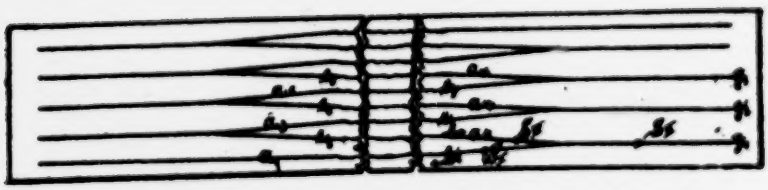


Fig. 2.

Translation.

SWISS PATENT 85751

Class 69 Published November 16, 1920

Dr. Eugen Alber, of Basle (Switzerland).

Talking machine with ribbon-shaped phonogram carrier.

(Application filed October 11, 1919, 6 p. m.)

The object of the present invention is a talking machine in which a mechanism moves a sound-ribbon which is provided with parallel adjacent sound-furrows and which is open at both ends, i. e. not closed upon itself, past a sound-box, and which is characterized by the fact that the sound is transferred by means of a needle to one and the same membrane not only in the forward, but also in the backward movement of the ribbon.

In what follows and in the annexed drawing the object of the invention is represented in Fig. 1 in a diagrammatic presentation in a specimen form of construction; Fig. 2 is a view of a form of embodiment of the sound-ribbon.

1 is intended to represent a mechanism which is able to move the conveyor cylinder 2 either clockwise or counter-clockwise as desired. In the drawing, the ribbon 3 is unwound from the drum *B* by this cylinder, is drawn past the membrane needle 4, gliding in the sound-furrows, of the sound-box 5, and is wound up on the drum *A*. The sound-arm, sound-amplifier, and the like have been omitted for the sake of simplicity. The two rollers 6 press the sound-ribbon against the cylinder 2. The sound-ribbon is provided, in a direction parallel with its length, with the sound-furrows a_1-e_1,

a_2-e_2, a_3-e_3 etc., which are arranged upon the ribbon in such a way that the beginnings and ends of the sound-furrows are alternately adjacent and that in each case the end of one sound-furrow and the beginning of the next succeeding one coalesce into one common furrow in which the sound-collecting needle glides during the reversal of the direction of the motion of the ribbon and which serves to guide the sound-collecting needle from the end of a sound-furrow that has just been traversed into the beginning of the next succeeding one. In Fig. 2, a_1, a_2, a_3 etc. denote the beginnings and e_1, e_2, e_3 etc. the ends of the sound-furrows; g_1, g_2, g_3 etc. are the common furrows. S_I represents the position of the sound-collecting needle, gliding in the end piece e_1, after the reproduction of the first selection has taken place, in which connection the sound-ribbon moves in the direction of the arrow located beside it; the needle is in the position S_{II}, i. e. in the common furrow g_1, after a stoppage of the movement of the ribbon has taken place. If the mechanism is now reversed and the ribbon consequently moved backwards in the direction of the arrow marked at a_2, then the beginning a_2 of the next succeeding sound-furrow glides under the membrane needle (position S_{III}), provided that the latter is slightly pressed or drawn in the direction lying in the plane of the marks, perpendicular to the line a_2, for example, under the influence of a spring acting upon the sound-box or of a weight, in consequence whereof the membrane needle is pressed close up against that edge of the common furrow g_1 which the latter has in common with a_2 (and not with e_1). The reversal from the forward movement to the backward movement of the ribbon is effected automatically.

The mechanism may be kept in motion by means of a spring drive mechanism, by means of an electric motor, or by means of any other mechanical power.

In the present example a phonograph sound-box has been sketched; for other sound-records a corresponding sound-box is naturally employed.

For sound-ribbons which possess several sound-furrow systems that are played simultaneously and supplement each other to constitute a selection, there is provided a number of sound-recording needles that corresponds with the number of sound-furrow systems.

The present talking machine may also be constructed in such a way that it moves a photographic film along also, simultaneously with a sound-ribbon. In Fig. 1, for example, there is mounted upon the axle of the conveyor-roller 2, for this purpose, also a conveyor-roller for the photographic film. The radii of these conveyor-rollers are to one another as the appurtenant film speeds. The two conveyor-rollers may also be mounted upon different axles that are separated from one another, if the latter are coupled with one another in such a gearing ratio that the conveyor-rollers, and thereby the two films, are given the requisite speed. Any departure from synchronism of the two films is thereby precluded. The drive and the regulation of the speed is always effected by the talking machine mechanism. With the aid of two axles that rotate in synchronism the mechanism of the cinematograph may also be separated entirely from the talking machine and may be placed as far from the latter as desired, if one of the axles running in synchronism moves the conveyor-wheel light-film and the other moves that of the sound-film with interposition of a speed-change gearing.

PATENT CLAIM.

Talking machine in which a mechanism moves an open sound-ribbon, provided with parallel adjacent sound-furrows, past a sound-box, characterized by the

fact that the sound is transferred by means of a needle to one and the same membrane not only in the forward, but also in the backward movement of the ribbon.

SUB-CLAIMS.

1. Talking machine in accordance with the patent claim, characterized by the fact that the reversal from the forward movement to the backward movement of the sound-ribbon is effected automatically.

2. Talking machine in accordance with the patent claim, in which in each case the end of one sound-furrow of the sound-ribbon and the beginning of the adjacent sound-furrow coalesce into one common furrow, characterized by the fact that the sound-collecting needle is pressed, during the moment of the change in direction of the motion of the sound-ribbon, close up against that edge of the common furrow which the latter has in common with the next succeeding sound-furrow.

3. Talking machine in accordance with the patent claim, characterized by the fact that the mechanism also moves a light-film simultaneously with a sound-ribbon.

4. Talking machine in accordance with the patent claim, characterized by the fact that the axle of the sound-ribbon conveyor-roller also moves a light-film simultaneously with the sound-ribbon.

5. Talking machine in accordance with the patent claim and sub-claim 3, characterized by the fact that the conveyor-rollers of the sound-film and light-film are arranged on separate, but mutually coupled axles.

6. Talking machine in accordance with the patent claim and sub-claim 5, characterized by the fact that the conveyor-rollers of the sound-ribbon and the light-film are coupled with one another with interposition of axles that run in synchronism.

Dr. Eugen Alber.

PLAINTIFFS' EXHIBIT NO. 2.

DISCLAIMER

To The Hon. Commissioner of Patents:

Your petitioner, American Tri-Ergon Corporation, a corporation organized and existing under the laws of the State of New York and having a place of business in the City, County and State of New York, represents that in the matter of certain inventions for which Letters Patent of the United States, No. 1,713,726, were granted on May 21, 1929 on an application filed by the inventors, Hans Vogt, Joseph Massolle and Josef Engl, said American Tri-Ergon Corporation is the owner of the entire right, title and interest under an assignment dated June 6, 1930 and recorded in the Transfers of Patents of the United States Patent Office July 3, 1930, Liber T-144, pp. 192-199, and other assignments referred to in said assignment, subject only to license rights for certain purposes only as referred to in said assignments, which license rights were granted to Tri-Ergon Musik A. G., a corporation of St. Gall., Switzerland, and all of which license rights Tri-Ergon Holding, A. G., a corporation of Switzerland, having a place of business at St. Gall., Switzerland, now claims to own; and that your petitioner has reason to believe that through inadvertence, accident or mistake, and without any fraudulent or deceptive intention, the specification and claims of said Letters Patent are too broad, including that of which said inventors were not the first inventors. Your petitioner therefore hereby enters this disclaimer to such parts of the claims which it does not choose to claim or hold by virtue of the patent or said assignments, to wit:

(a) All combinations and methods set forth in the specification and claims of the patent, except as embodied respectively in apparatus wherein and methods whereby sound is translated by light to or from a film strip moving uniformly past said light.

(b) The method as set forth in claim 9, except wherein the uniformity of movement of the film past the translation point is effected by subjecting the portion of the film passing said point to the control of the inertia of a rotating weighty mass.

(c) The combination as set forth in claim 13, except wherein a flywheel is operatively connected with the film through means which imparts uniformity of motion of the flywheel to the film.

(d) The combination as set forth in claim 17, except wherein a sprocket engaging the carrier forms a part of the carrier progressing means and a substantial portion of the periphery of the cylinder is in contact with the carrier in its travel from the intermediate point to said sprocket.

(e) The method as set forth in claim 18, and said method as incorporated in claim 19, except wherein the inertia control is effected by passing the film over a rotating member and so applying inertia thereto as to eliminate substantially all irregularities in its rotation.

Signed at New York, in the County of New York and State of New York, this 31st day of May, 1933.

AMERICAN TRI-ERGON CORPORATION,
By W. Fox
(William Fox) President.

Witness:

PAGE S. HASELTON

Tri-Ergon Holding, A. G., a corporation of Switzerland having a place of business at St. Gall., Switzerland, as to all interest which it claims in U. S. Patent No. 1,713,726 hereby joins in the foregoing disclaimer and ratifies and approves the same.

Signed at New York, County of New York and State of New York, this 31st day of May, 1933.

TRI-ERGON HOLDING, A. G.,
By MAX HELD
A Director with power to
sign for the Corporation.

Witness:

S. MORTIMER WARD, JR.

PLAINTIFFS' EXHIBIT NO. 3.

BESCHEINIGUNG.

Die Herren Hans Vogt in Berlin-Schöneberg, Joseph Massolle und Dr. Joseph Engl in Berlin-Grunewald haben im Deutschen Reiche ein Gesuch um ein Erfindungspatent für

"Gleichlaufeinrichtung für Phonographen mit linearem Phonogrammträger"

am 22. Mai 1920 beim Reichspatentamt hinterlegt.

Die angehefteten Stücke sind eine richtige und genaue Wiedergabe der ursprünglichen Unterlagen dieser Patentanmeldung.

Berlin, den 8. März 1933.

Der Präsident des Reichspatentamts.
J. V.
BRISKEN

(Reichspatentamt)
(Stempel)

Gesehen zur Beglaubigung der vorstehenden Unterschrift.
Berlin, den 28, März 1933.
Das Auswärtige Amt des Deutschen Reichs.

(Stempel)
21—5 RM

Im Auftrag:

REIMKE
Reimke

Pat 387 058.

Schöneberg, den 20. 5. 1920.

Patentanmeldung.

Gleichlaufeinrichtung für Phonographen mit linearem Phonogrammträger.

Bei phonographischen Darbietungen hängt Qualität und Originaltreue der reproduzierten Klänge und Laute von der Güte der Aufzeichnung und von der Geschwindigkeit ab, mit der sich der Phonogrammträger an der Steuerstelle (Magnet, Lichtlinie, Schalldosenstift u. ä.) vorbeibewegt. Den zu erfüllenden Bedingungen, dasz erstens die mittlere Aufnahme- und Wiedergabegeschwindigkeiten einander gleich sein müssen und zweitens die Vorbeibewegung des Phonogrammträgers an der Steuerstelle vollkommen kontinuierlich erfolgen musz, entsprechen die bekannten Phonographen, deren Phonogrammträger aus Bändern, Drähten und dergl. bestehen, nicht. Es sind weder Einrichtungen bekannt, die eine genaue Kontrolle und Regulierung der Phonogrammträgergeschwindigkeit unmittelbar an der Steuerstelle gestatten, noch gewährleisten diese Phonographen eine absolute augenblickliche Bewegungskonstanz. Denn Versuche haben gezeigt dasz der Tonträger, die für ihn fast immer einen Reibungswiderstand darstellende Steuerstelle meist nicht kontinuierlich, sondern ruckweise passiert. Besonders tritt diese Störerscheinung zu Tage, wenn der Tonträger beispielsweise als perforiertes Filmband ausgebildet ist und, synchron mit einem Bildfilm ablaufend, für die Zwecke des sprechenden Kinematographen Verwendung findet. Hier können auszer den schon erwähnten, von der Reibung abhängigen Unregelmäszigkeit die intermittierenden Bewegungen des Bildbandes, der Einflusz der Zackenrollen und der Riemenverbindungsstellen eine derartige Diskontinuität an der Steuerstelle des Tonbandes hervorrufen, dasz genuszreiches Hören zur Unmöglichkeit wird.

Die Erfindung beseitigt diese Nachteile. Sie gewährleistet unmittelbar an der Steuerstelle sowohl eine regelbare mittlere, als auch eine augenblickliche, absolut kontante Fortbewegungsschnelligkeit des Phonogrammträgers. Dies wird erreicht, indem die Aufzeichnungs- oder Steuerstelle des an Masse geringen längsbewegten Tonträgers somit einer rotierenden, weit gröszerem Masse gekuppelt wird, dasz die, keinen schnellen zeitlichen Schwankungen unterworfene Umdrehungszahl der letzteren bestimmend für die Längsgeschwindigkeit des Tonbandes ist.

In Figur 1 ist die Erfindung im Prinzip beispielsweise für den Wiedergabeteil eines optischen Phonographen veranschaulicht. f ist der Tonfilm, der ein von dem optischen System o kommendes Lichtbündel steuert, das dann die lichtelektrische Zelle z verschieden stark (im akustischen Rhythmus) belichtet. Die Führungsleisten zz halten den Tonfilm der von einer nicht gezeichneten Rolle angetrieben wird, genau in der Brennlinie bezw. tragen einen schmalen Spalt. Kurz vor oder nach dieser Führung passiert der Film zwei mit Druck gegeneinander anliegende Rollen r_1, r_2, deren eine mit einer Schwungmasse m verbunden ist. Die den Gleichlauf bewirkenden Rollen können zur Führung des Tonbandes benutzt werden. Gegebenenfalls können zwei solcher Gleichlauferzeuger vorhanden und so miteinander mittels Riemen u. dgl. verbunden sein, dasz eine kleine Umdrehungsdifferenz den Film, das Stahlband oder dergl. an der Steuerstrecke während des Laufens andauernd gespannt hält.

Fig. 2 zeigt ein derartiges Ausführungsbeispiel. Der Film f wird von zwei Rollenpaaren r_1 r_2 und r_3 r_4 angetrieben. r_3 r_4 besitzen eine höhere Umlaufzahl wie r_1 r_2. Erzielt wird dies durch die Antriebsscheiben s_1 s_2, von denen s_2 einen kleineren Durchmesser besitzt. Die Achse der Rolle r_2 bezw. m ist auszerdem mit einem nicht gezeichneten Umdrehungszähler und

Umdrehungsregler verbunden, die durch Einwirken auf den Antriebs motor die mittlere Wiedergabegeschwindigkeit einhalten. Dasz eine derartige geregelte Wiedergabe nur Sinn hat, wenn man auch bei der Aufnahme dieselben Masznahmen anwendet, ist selbstverständlich.

Patentansprüche.

1.) Einrichtung für Phonographen wit linearem Phonogrammträger, insbesondere für die Zwecke des sprechenden Films, dadurch gekennzeichnet, dasz zwecks Erzielung immer konstanter und regelbarer mittlerer Längsgeschwindigkeit an der Steuerstelle der Phonogrammträger mit einer rotierenden Schwungmasse gekuppelt ist.

2.) Ausführungsform nach Anspruch 1, dadurch gekennzeichnet, dasz Geschwindigkeitszähler und Geschwindigkeitsregler Anwendung finden.

3.) Ausführungsform nach Anspruch 1 und 2, dadurch gekennzeichnet, dasz zwei Rotationssystem den Phonogrammträger steuern.

4.) Ausführungsform nach Anspruch 3, dadurch gekennzeichnet, dasz die Filmantriebsrollen der Rotationssysteme verschiedene Umfangsgeschwindigkeit besitzen.

5.) Ausführungsform nach Anspruch 1, dadurch gekennzeichnet, dasz als Kupplung zwischen Phonogrammträger und Rotationskörper eine Reibungskupplung dient.

Fig. 1.

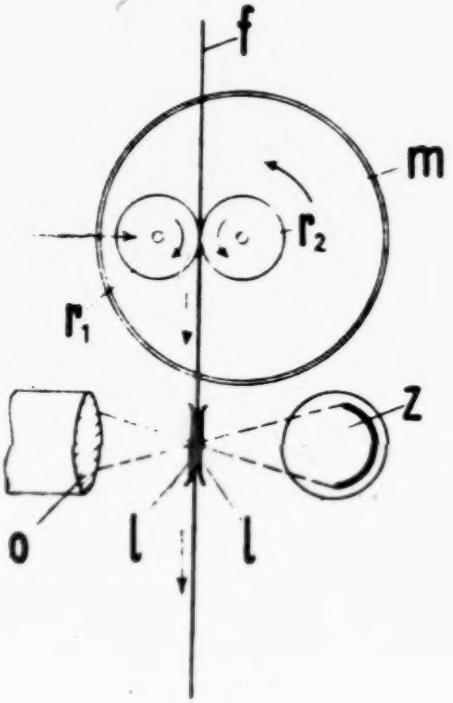
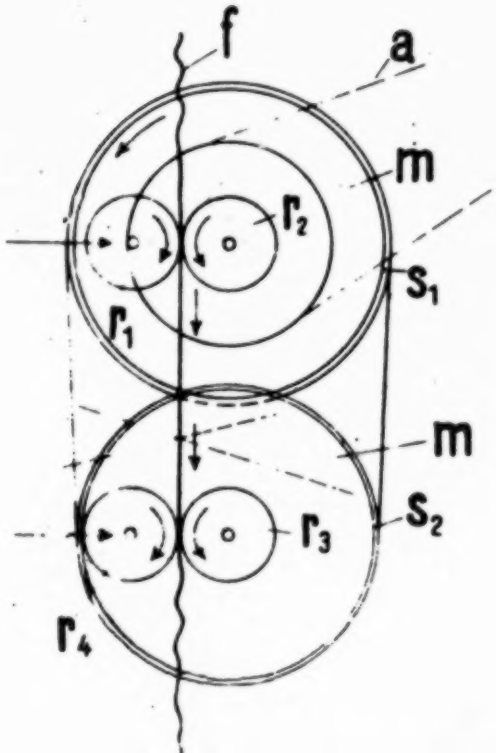


Fig. 2.



AMERICAN CONSULAR SERVICE

German Reich,
Province of Brandenburg,
Consulate General of the
United States of America
at Berlin. } ss.

I, Hugh Corby Fox Vice Consul of the United States of America at Berlin, German Reich, duly commissioned and qualified, do hereby certify that Brisken whose true signature and official seal are, respectively, subscribed and affixed to the foregoing instrument, was at the time of subscribing same an official of the Government Patent Office of the German Reich, duly commissioned and by law authorized to execute such acts, and that his signature and official seal affixed thereto are genuine, and as such are entitled to full faith and credit.

IN WITNESS WHEREOF I have hereunto set my hand and seal of the Consulate General at Berlin, German Reich, this 28th day of March 1933.

HUGH CORBY FOX
(Seal) Vice Consul of the United States of America.

Service No. 01939. $2.—Mk. 8.48.

(American Consulate General, Berlin, Germany. Rec'd March 28, 1933. $2.00 Fee Stamp.)

Translation.

CERTIFICATE.

Messrs. Hans Vogt in Berlin-Shöneberg, Joseph Massolle and Dr. Josef Engl in Berlin-Grunewald, have filed in the German Reich on May 22nd 1920 an application for an invention patent at the Reich's Patent Office for "Constant Speed Device for Phonographs with Linear Phonogram Carriers". The attached sheets are a correct and accurate reproduction of the original documents of this patent application.

Berlin, March 8th 1933

The President of the Reich's Patent Office
by
(signed) Brisken

Seal Reich's Patent Office	Seal Foreign Office of The German Reich (5 Reichsmark)	Seen for certification of the above signature Berlin, March 28th 1933. The Foreign Office of the German Reich by (signed) Reimke

Patent 387058.

Schoneberg, May 20th 1920

Constant Speed Device for Phonographs with Linear Phonogram Carriers.

Patent Application.

Quality and fidelity of reproduced sounds and tones in phonographic presentations depend on the quality of the record and on the speed at which the phonogram carrier moves past the control point (magnet, line of light, phonograph needle, etc.). The known phonographs, whose phonogram carriers consist of ribbons, wires and the like, do not satisfy the conditions to be fulfilled that 1) the mean speed of recording and reproducing must be the same and that 2) the motion of the phonograph carrier past the control point must take place in a perfectly continuous way. Not only are no devices known which allow an accurate control and regulation of the speed of the phonogram carrier right at the control point, nor do these phonographs afford an absolute, momentary constancy of motion. For experiments have shown that the sound carrier does not pass the point of control which nearly always constitutes for it a frictional resistance, in most cases in a continuous but in a jerky motion. This disturbing phenomenon occurs particularly when the sound carrier is constituted as a perforated film ribbon and, running in synchronism with a picture film, is employed for the purposes of the talking cinematograph. In this case the intermittent motions of the picture strip, the influence of the sprocket drums and of the points of belt connections may cause, in addition to the above mentioned irregularity dependent on the friction, such a discontinuity at the control point of the sound ribbon that listening with pleasure becomes an impossibility.

The invention eliminates these drawbacks. It affords right at the control point a controllable means

as well as a momentary, absolutely constant travel speed of the phonogram carrier. This is attained by coupling the point of recording or of control of the longitudinally sound carrier of small mass to a rotating, much larger mass in such a way that the number of revolutions of the latter which is not subject to any quick temporal fluctuations determines the longitudinal velocity of the sound ribbon.

In Fig. 1 the invention is shown in principal by way of example for the reproducing portion of an optical phonograph. f is the sound film which controls a pencil of light coming from the optical system o, which in turn illuminates the photoelectric cell z with varying intensity (in the acoustic rhythm). The guide strips z z *) hold the sound film which is driven by a roller (not shown) exactly in the focal line or carry a narrow slit. Shortly before or after having gone through this guide the film passes between two rollers r_1, r_2, which apply against one another with pressure and one of which is connected to a flywheel mass m. The rollers which effect constant speed may also be used to guide the sound ribbon. Under suitable circumstances two such producers of constant speed may be present connected by belts and the like in such a way that a small difference in rotation keeps the film, the steel ribbon or the like while it is running continually under tension at the control section.

Fig. 2 shows such an example of construction. The film f is driven by two pairs of rollers r_1 r_2 and r_3 r_4. r_3 r_4 have a higher speed of rotation than r_1 r_2. This is attained by the driving pulleys s_1 s_2, of which s_2 has a smaller diameter. The shaft of the roller r_2 or m is connected in addition with a revolution counter and speed governor, not shown, which maintain the mean speed of reproduction by acting on the driving

Note: z z in the text, but 11 in the drawing.

motor. It goes without saying that a reproduction regulated in such a manner is sensible only if the same measures are employed in recording also.

PATENT CLAIMS.

1) Device for phonographs with linear phonogram carrier, particularly for the purposes of the talking film, characterized by the fact that the phonogram carrier is coupled to a rotating flywheel mass m in order to attain an always constant and controllable mean longitudinal speed at the point of control.
2) Form of construction according to claim 1) characterized by the fact that revolution counters and speed governors are employed.
3) Form of construction according to claim 1) and 2) characterized by the fact that two rotating systems control the phonogram carrier.
4) Form of construction according to claim 3) characterized by the fact that the rollers of the rotating system which drive the film have different peripheral speeds.
5) Form of construction according to claim 1) characterized by the fact that coupling by friction serves to couple the phonogram carrier to the rotating body.

PLAINTIFFS' EXHIBIT NO. 4.

BESCHEINIGUNG.

Die Herren Hans Vogt in Berlin-Wilmersdorf, Joseph Massolle in Berlin-Grunewald und Dr. Joseph Engl in Berlin-Grunewald haben im Deutschen Reiche ein Gesuch um ein Erfindungspatent für

"Gleichlaufeinrichtung für lineare Phonogrammträger"

am 24. März 1921 beim Reichspatentamt hinterlegt.

Die angehefteten Stücke sind eine richtige und genaue Wiedergabe der ursprünglichen Unterlagen dieser Patentanmeldung. Die Zeichnung ist am 9. April 1921 nachgereicht worden.

Auf die obige Patentanmeldung ist das Patent 389 318 erteilt worden.

Berlin, den 11. März 1933.
Der Präsident des Reichspatentamts.

I. V.
RUHFUS

(Reichpatentamt Stempel)
(Stempel)
21—5 RM

Gesehen zur Beglaubigung der vorstehenden Unterschrift.
Berlin, den 21. März 1933.
Das Auswärtige Amt des Deutschen Reichs.
Im Auftrag:

REIMKE
Reimke

Pat. 389 318.

Gleichlaufeinrichtung für lineare Phonogrammträger.

Patentanmeldung.

Die Aufzeichnung und Wiedergabe von Schallwellen unter Benutzung von linearen Phonogrammträgern wie Filmbändern, Stahldrähten u. a. gelingt nach Behebung aller anderen entgegenstehenden Schwierigkeiten nur dann einwandfrei, wenn die Geschwindigkeit des Tonträgers bei Aufnahme und Wiedergabe die gleiche ist und in beiden Fällen keinerlei Geschwindigkeitsschwankungen auftreten. Sehr empfindlich für geringste Geschwindigkeitsschwankungen sind besonders Musikdarbietungen. Infolgedessen hat man bisher z. B. Phonographen und Grammophone mit Geschwindigkeitsreglern versehen. Bei diesen Einrichtungen kommt jedoch dem Gleichlaufproblem nicht die Bedeutung zu, wie bei den Phonographen mit linearen Phonogrammträgern, da bei ihnen der Tonträger aus einer, eine ziemliche Massenbeschleunigung aufweisenden Walze oder Scheibe besteht, die kleine Unregelmäszigkeiten in der Bewegung, beispielsweise verursacht durch den Antrieb, ausgleicht. Bei den Phonographen mit linearen Schallträgern dagegen weist das in einem gegebenen Zeitpunkt in Aktion befindliche Trägerstück fast keine praktisch ins Gewicht fallende Masse auf. Unregelmäszigkeiten in der Fortbewegung, beispielsweise verursacht durch die Zacken, Zähne, Riemen, Verbindungsstellen u. dgl. oder durch die Reibung an der Steuerstelle (Spalt, Magnet, Kondensator) machen sich deshalb bei ihnen weit mehr geltend und fälschen so die Periodizität der aufgenommenen Klangereignisse um grosze Beträge.

Erfindungsgemäsz wird dieser Nachteil, mit dem alle bisher bekannten Antriebsvorrichtungen für lineare Phonogrammträger behaftet sind, dadurch beseitigt, dasz dem leichten Tonträgerstück an der Steuer-

stelle die Eigenschaft einer schweren Masse gegeben wird. Dies wird dadurch erreicht, dasz der Träger (Filmband oder ähnliches) fest an eine oder mehrere, mit einer schweren Schwungmasse verbundene Rollen angepreszt wird, sodasz der Träger sich ebenso gleichmäszig wie Rollen und Schwungmasse fortbewegt.

Beispielsweise Ausführungsformen der Erfindung sind in den Figuren dargestellt. Der Phonogrammträger, der bei diesen Ausführungsformen ein Filmband ist, bewegt sich über die zweckmäszig durch Zahn- oder Riementrieb gekuppelten Rollen r_1 r_2, von denen am besten die direkt vom Motor angetriebene Rolle mit Zähnen versehen ist. Eine oder auch beide Rollen sind mit Schwungmassen m_1 m_2 starr verbunden, die dem zwischen ihnen laufenden, gespannten Filmstück f die erforderliche Gleichmäszigkeit in seiner Bewegung geben. Zwischen den Rollen r_1 r_2 befindet sich zweckmäszig in einer Hülse h das lichtelektrisch empfindliche Organ z, das von einem aus o austretenden und den Film passierenden Lichtstrahl beeinfluszt wird. Die Rollen dr_1 dr_2 drücken den Film an die Transportrolle r_2 an.

Eine andere Ausführung der Erfindung, wobei die kleinen Unregelmäszigkeiten, die häufig die Zähne oder die beispielsweise leicht zu mechanischen Schwingungen neigenden Filmstrecken zwischen r_1 und r_2 verursachen, vermieden werden, ist in Figur 2 dargestellt.

Der Film f wird durch die Rolle r_1 der Steuerstelle s zu- und durch die Rolle r_2 von der Steuerstelle weggeführt. Zwischen diesen Transportrollen wird der Film über den Umfang einer gröszeren Rolle R geleitet, auf der er durch Adhäsion auch während der Drehbewegung fest aufliegt. Da die Rolle R mit der Schwungmasse m starr verbunden ist, bezw. selbst als Schwungmasse ausgebildet sein kann, bewegt sich der Film ebenso gleichmäszig weiter wie die Oberfläche der Rolle R. Zum Andrücken des Filmes an die Rolle R

sowie zum Ausgleich von Bewegungsunregelmäszigkeiten dienen die federnd gelagerten Rollen dr_1, dr_2. Die zur Belichtung, bezw. Durchleuchtung des Filmes erforderlichen Lichtstrahlen werden vermittels des Objektivs o in Form einer schmalen Linie auf den Film geworfen. Bei der Wiedergabe treten die Lichtstrahlen durch das Filmband hindurch und fallen auf die z. Tl. in ihrem Innern angebrachte Photozelle z. Zu diesem Zweck ist entweder die Rolle teilweise durchsichtig (aus Glas) oder der die Tonzeichen tragende Teil des Films ragt über die undurchsichtigen Teile der Rolle hinweg.

Patentansprüche.

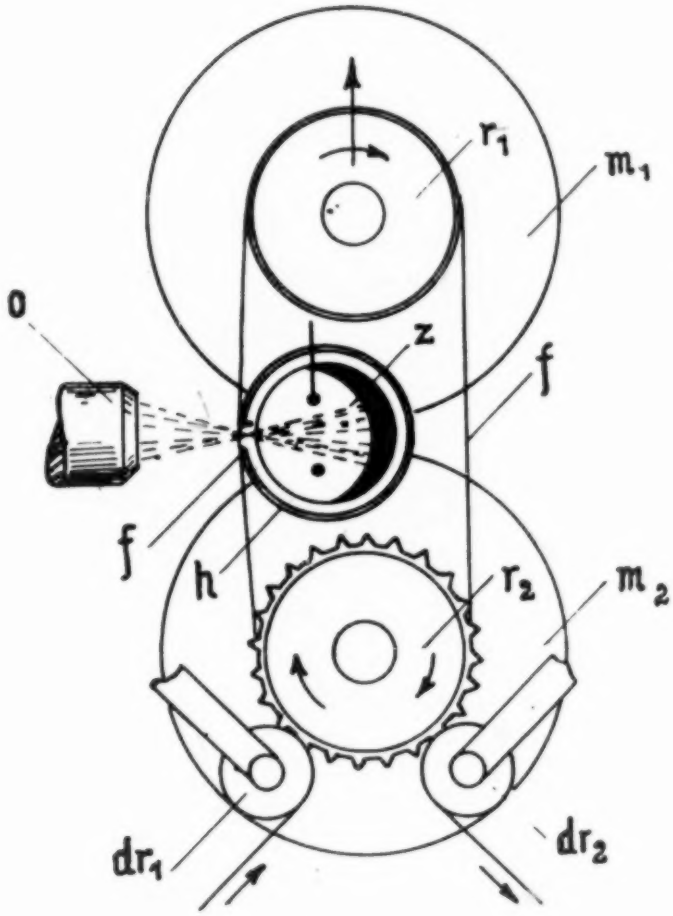
1.) Gleichlaufeinrichtung für lineare Phonogrammträger, dadurch gekennzeichnet, dasz dem Phonogrammträger an der Aufnahme- bezw. Steuerstelle konstante Geschwindigkeit durch eine sich mit ihm bewegende schwere Masse erteilt wird.

2.) Antriebsvorrichtung nach Anspruch 1, dadurch gekennzeichnet, dasz sich die Aufnahme- bezw. Steuerstelle des Phonogrammträgers zwischen zwei mit Schwungmasse versehenen Rollen befindet.

3.) Antriebsvorrichtung nach Anspruch 1, dadurch gekennzeichnet, dasz sich die Aufnahme bezw. steuernde Stelle des Phonogrammträgers auf dem Umfang einer mit Schwungmasse versehenen Rolle befindet.

4.) Antriebsvorrichtung nach Anspruch 1-3, dadurch gekennzeichnet, dasz die Schwungmasse, bezw. die damit verbundene Fortbewegungsrolle mit Umdrehungszählern und Umdrehungsreglern verbunden ist.

fig. 1 14



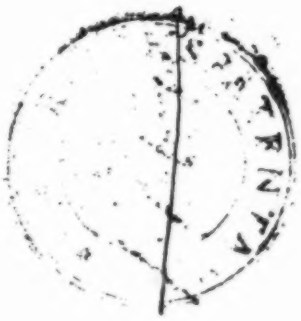
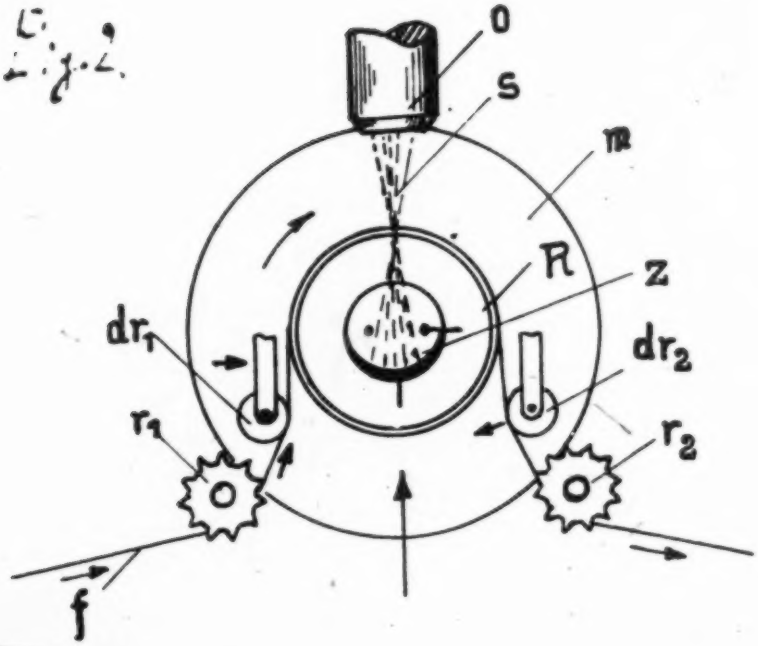


fig. 2.



AMERICAN CONSULAR SERVICE

German Reich,
Province of Brandenburg,
Consulate General of the United States of America at Berlin. } ss.

I, Hugh Corby Fox Vice Consul of the United States of America at Berlin, German Reich, duly commissioned and qualified, do hereby certify that Ruhfus whose true signature and official seal are, respectively, subscribed and affixed to the foregoing instrument, was at the time of subscribing same an official of the Government Patent Office of the German Reich, duly commissioned and by law authorized to execute such acts, and that his signature and official seal affixed thereto are genuine, and as such are entitled to full faith and credit.

IN WITNESS WHEREOF I have hereunto set my hand and the seal of the Consulate General at Berlin, German Reich, this 28th day of March 1933.

HUGH CORBY FOX,
(Seal) Vice Consul of the United States of America.

Service No. 01934. $2.—Mk. 8.48.

(American Consulate General, Berlin, Germany. Rec'd March 28, 1933. $2.00 Fee Stamp.)

Translation.

CERTIFICATE.

Messrs. Hans Vogt in Berlin-Wilmersdorf, Joseph Massolle in Berlin-Grunewald and Dr. Joseph Engl in Berlin-Grunewald have filed an application for an invention patent in the German Reich with the patent office of the Reich on March 24th, 1921 for "Constant Speed Device for Linear Phonogram Carriers".

The attached sheets are a correct and accurate copy of the original documents of this patent application. The drawing has been filed afterwards on April 9th, 1921.

Patent 389318 has been granted on the above patent application.

Berlin, March 11th, 1933.

The President of the Reich's Patent Office

by

(signed) Ruhfus

Seal Reich's Patent Office

Seal Foreign Office of the German Reich

(5 Reichsmark)

Seen for certification of the above signature

Berlin, March 21st, 1933 The Foreign Office of the German Reich

by

(sign.) Reimke.

Patent 389318.

Constant Speed Device for Linear Phonogram Carriers.

Patent Application.

The recording and reproduction of sound waves by means of linear phonogram carriers such as strips of film, steel wires and the like after elimination of all other interfering difficulties is successful only if the speed of the sound carrier is the same for recording and reproducing and if no fluctuations in speed occur in both cases. Musical presentations are especially sensitive for the least fluctuations in speed. Up to now phonographs and gramophones have therefore been equipped with speed governors. The problem of constant speed in these devices is, however, not of such importance as with the phonographs with linear phonogram carriers, since their sound carrier consists of a roller or disc which have a considerable moment of inertia and which smooth out little irregularities of the motion caused, e. g. by the driving mechanism. But in phonographs with linear sound carriers the piece of the carrier which is in action at a certain moment exhibits practically no mass. Irregularities in speed, such as caused, e. g., by sprockets, gears, belts, connection points and the like, or by friction at the point of control (slit, magnet, condenser) make themselves felt much more and thus falsify the periodicity of the recorded sound events by large amounts.

According to the invention this drawback inherent in all driving mechanisms for linear phonogram carriers known up to now is eliminated by giving the light piece of sound carrier at the control point the quality of a heavy mass. This is accomplished by pressing the carrier (strip of film or the like) tight against one or several rollers, which are connected to a heavy rotational mass so that the carrier moves along as continuously as rollers and mass.

Examples of forms of construction of the invention are shown in the figures. The phonogram carrier, which in these forms of construction is a strip of film, moves over the rollers r_1 and r_2 preferably coupled by sprocket or belt drive of which the one driven directly by the motor is best equipped with sprockets. One or both rollers are rigidly connected to rotating masses m_1 and m_2 which give the piece of film f running tight between them the required uniformity of motion. The photoelectrically sensitive organ z is preferably placed between the rollers r_1 and r_2 in a container h which is acted upon by a light ray emerging from o and passing through the film. The rollers dr_1 and dr_2 press the film against the transport roller r_2.

Another form of construction of the invention whereby the small irregularities often caused by the sprockets or by the piece of film, e. g. between r_1 and r_2 which is liable to perform mechanical oscillations, are eliminated, is shown in fig. 2.

The film f is brought by the roller r_1 to the point of control s and carried away from that point by the roller r_2. The film is guided between these two rollers over the circumference of a larger roller R on which it adheres firmly also during the rotary motion. Since the roller R is rigidly connected with the fly wheel mass m or since it may be made in the form of a fly wheel itself, the film moves on just as uniformly as the surface of the roller R. The rollers r_1 and r_2 held by springs serve to press the film against the roller R and to smooth out irregularities of the motion. The light rays necessary for illuminating or "transluminating" the film are projected by means of the objective o on the film in the form of a narrow line. In reproducing the light rays go through the strip of film and impinge on the photo-cell z which is partly inside R. For this purpose the roller is partly transparent (made out of glass) or the part of the film which carries the sound record protrudes over the opaque parts of the roller.

PATENT CLAIMS.

1.) Constant speed device for linear phonogram carriers characterized by the fact that constant speed is imparted to the phonogram carrier at the point of recording or of control, resp. by a heavy mass which moves with it.

2.) Driving device (in accordance with claim 1) characterized by the fact that the point of recording or of control resp. of the phonogram carrier is situated between two rollers equipped with rotational mass.

3.) Driving device (in accordance with claim 1) characterized by the fact that the recording or the control point, resp. of the phonogram carrier is situated on the circumference of a roller with fly wheel mass.

4.) Driving mechanism according to claim 1 to 3 characterized by the fact that the rotational mass or the transporting roller connected with it is connected to revolution counters and speed governors.

PLAINTIFFS' EXHIBIT NO. 5.

BESCHEINIGUNG.

Die Herren Joseph Massolle in Berlin-Grunewald, Hans Vogt in Berlin-Wilmersdorf und Dr. Joseph Engl in Berlin-Grunewald haben im Deutschen Reiche ein Gesuch um ein Erfindungspatent unter der Bezeichnung

"Antriebsvorrichtung für Tonbänder"

am 9. April 1921 beim Reichspatentamt hinterlegt.

Die angehefteten Stücke sind eine richtige und genaue Wiedergabe der ursprünglichen Unterlagen dieser Patentanmeldung.

Berlin, den 3. März 1933.

Der Präsident des Reichspatentamts.
J. V.
LÜBCKE

(Reichspatentamt)

Gesehen zur Beglaubigung der vorstehenden Unterschrift.
Berlin, den 28. März 1933.
Das Auswärtige Amt des Deutschen Reichs.
Im Auftrag:

REIMKE
Reimke

(Stempel)
21—5 RM

Pat. 389 319.

Berlin-Tempelhof, den 1. April 1921.

Antriebsvorrichtung für Tonbänder.

Zusatz zu Patent vom 24.3.21.

Patentanmeldung.

Im Hauptpatent vom 24.3.1921 ist eine Gleichlaufeinrichtung für Tonbänder angegeben, nach welcher letztere an der Projektionsstelle zwecks Konstanthaltung der Geschwindigkeit mit einer Schwungmasse gekuppelt sind. Der Antrieb des Tonbandes erfolgt jedoch nicht unmittelbar an der Projektionsstelle, sondern vor oder hinter derselben. Nach vorliegender Erfindung wird die Antriebsstelle des Tonbandes unmittelbar an die Projektionsstelle verlegt. Das Antriebsglied läszt sich dann so ausgestalten, dasz das Ein- und Auskämmen der Fortshaltzähne in die Perforation ohne Rückwirkung auf die Geschwindigkeit des Bildbandes an der Projektionsstelle ist.

Die Figur zeigt ein Ausführungsbeispiel. Die Achse a, gelagert bei b und c, trägt an einem Ende die Fortschaltrolle d, die mit den üblichen, in die Perforation des Tonbandes eingreifenden Zacken versehen ist. Auf einen Teil des Umfanges dieser Rolle, dem Abstand der Druckrollen e und f voneinander entsprechend, liegt der Film g fest auf. Mit der Achse verbunden sind ferner die Antriebsscheibe h, die auch ein Zahnrad oder ein anderes zweckdienliches Mittel sein kann, sowie die Schwungmasse i, welche der Achse und damit der Rolle d gleichförmige Drehgeschwindigkeit erteilt. Infolgedessen bewegt auch das Tonband sich mit gleichförmiger Geschwindigkeit, beispielsweise in der Richtung f–e. Diese Rollen e–f drücken das Band dabei fest an die Rolle d an, sodasz es auf der ganzen Länge von f bis e infolge der in die Perforation eingreifenden Schaltzähne unverrückt aufliegt. Das Ein- und Auskämmen der Schaltzähne erfolgt dabei unter dem Druck der Rollen f und e, sodasz sich Erschütterungen des Bildbandes an der Projektionsstelle nicht mehr bemerkbar machen. Vorteilhaft werden die

freien Filmenden g–g durch Vorwickelrollen in der bei Bildkinematographen üblichen Weise so geführt, dasz sie eine leichte Schleife bilden. Für Aufnahmezwecke, wobei das aufzuzeichnende, rythmisch gesteuerte Licht das Tonband nur an der Schichtoberfläche zu belichten braucht, kann eine massive Rolle d verwendet werden, auf welcher das Tonband mit seiner ganzen Breite aufliegt.

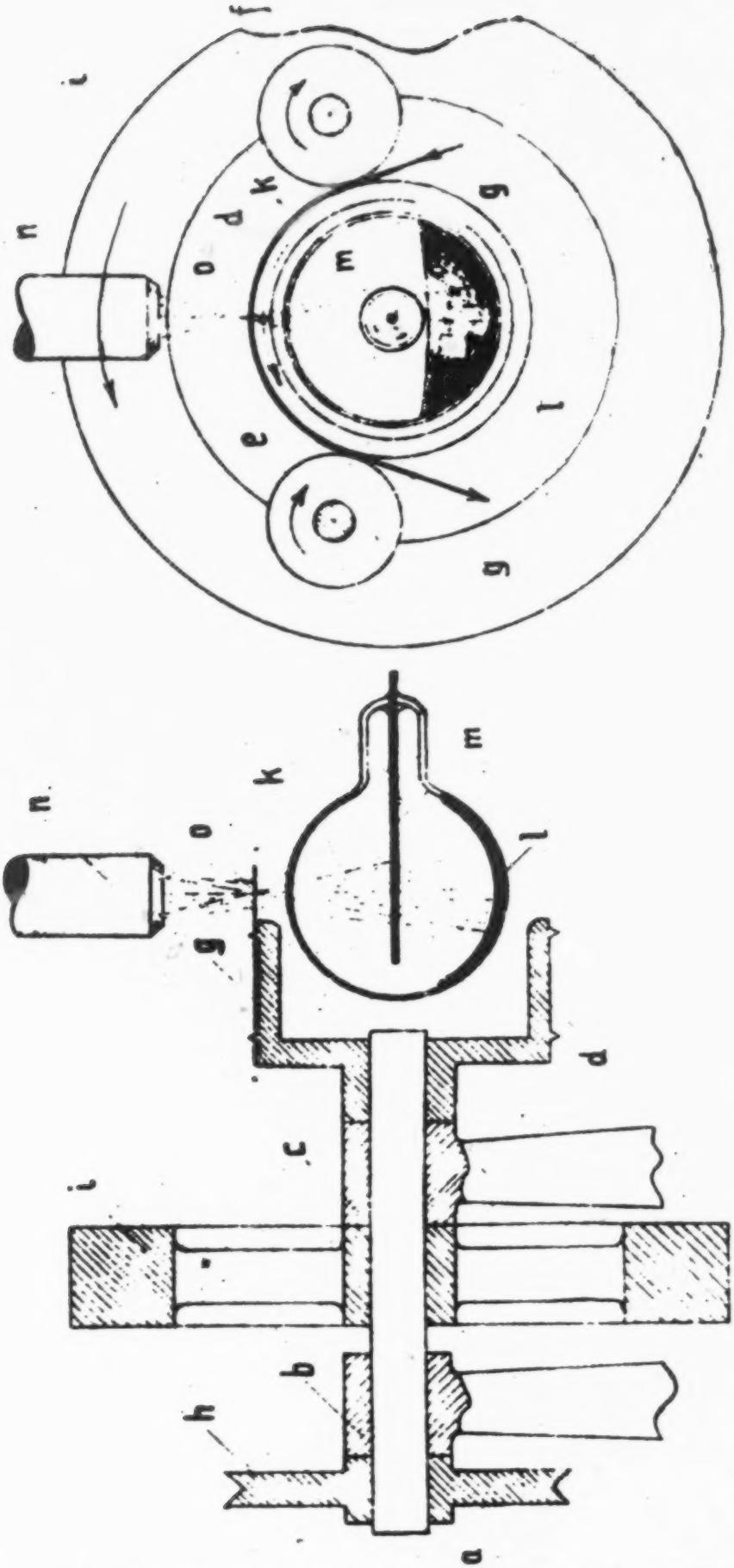
Für Wiedergabezwecke, wobei das durch ein Objektiv n in einer schmalen Linie zusammengefaszte Licht der Projektionslichtquelle bekanntlich durch den Film auf das lichtempfindliche Organ, z. B. die Zelle k mit der Kathode 1 und der Anode m, fällt, ist eine besonders konstruierte Rolle erforderlich, d in der Figur ist ein Ausführungsbeispiel, bei welchem das die Tonzeichen tragende Stück des Bandes über den Rand der Rolle hinausragt. Es können dabei die Tonzeichen auch zwischen den beiden Perforationsreihen liegen, indem nur eine Perforationsreihe zur Fortschaltung benutzt wird und die andere Seite des Tonbandes entweder ohne besondere Führung mitläuft, oder über ein mitlaufendes, bezw. besonders angetriebenes Rad mit oder ohne Schaltzähne läuft.

Patentansprüche.

1.) Antriebsvorrichtung für Tonbänder nach Patent vom 24.3.1921, dadurch gekennzeichnet, dasz die das Tonband fortbewegende Zackenrolle unmittelbar an der Projektionsstelle des Tonbandes wirksam ist.

2.) Antriebsvorrichtung nach Anspruch 1, gekennzeichnet durch Vorwickelrollen, welche die freien Filmenden vor und hinter der Zackenrolle in an sich bekannter Weise vorwickeln.

3.) Antriebsvorrichtung nach Anspruch 1, dadurch gekennzeichnet, dasz für Wiedergabezwecke der mit den Tonzeichen versehene Teil der Tonbänder über die Zackenrolle hinausragt, sodasz das Lichtstrahlenbündel ungehindert auf das lichtelektrische Organ fallen kann.


n
o
p
k
e
f
g
m
l
i
c
b
h
d

AMERICAN CONSULAR SERVICE.

German Reich,
Province of Brandenburg,
Consulate General of the United States of America at Berlin. } ss.

I, Hugh Corby Fox Vice Consul of the United States of America at Berlin, German Reich, duly commissioned and qualified, do hereby certify that Lübcke whose true signature and official seal are, respectively, subscribed and affixed to the foregoing instrument, was at the time of subscribing same an official of the Government Patent Office of the German Reich, duly commissioned and by law authorized to execute such acts, and that his signature and official seal affixed thereto are genuine, and as such are entitled to full faith and credit.

IN WITNESS WHEREOF I have hereunto set my hand and the seal of the Consulate General at Berlin, German Reich, this 28th day of March 1933.

HUGH CORBY FOX,
Vice Consul of the United States
(Seal) of America.

Service No. 01937. $2.—Mk. 8.48.

(American Consulate General, Berlin Germany. Rec'd March 28, 1933. $2.00 Fee Stamp.)

Translation.

CERTIFICATE

Messrs. Joseph Massolle in Berlin-Grunewald, Hans Vogt in Berlin-Wilmersdorf, and Dr. Josef Engl in Berlin-Grunewald, have filed an application for an invention patent under the title "Driving Contrivance for Sound Ribbons" with the Reich's Patent Office on April 9th, 1921. The attached sheets are a correct and accurate reproduction of the original documents of this patent application.

Berlin, March 3rd, 1933
The President of the Reich's Patent Office
by
(signed) Lübcke

SEAL
Reich's Patent Office

Seen for certification of the above signature Berlin, March 28th, 1933
The Foreign Office of the German Reich
by
(signed) Reimke

SEAL
Foreign Office of the German Reich
(5 Reichsmark)

Patent 389319

"Driving Contrivance for Sound Ribbons"

PATENT APPLICATION

In the main patent of March 24th 1921 a constant speed device for sound ribbons has been shown according to which the latter are coupled at the point of projection to a rotational mass in order to keep the speed constant. The drive however did not act on the sound ribbon immediately at the point of projection but before or after the ribbon had passed it. According to the present invention the driving point of the sound ribbon has been removed immediately to the point of projection. The driving member may then be designed in such a way that the sprockets engage in and disengage from the perforations without reacting on the speed of the sound ribbon at the point of projection.

The figure shows an example of the construction. The shaft a with bearings b and c carries at one end the sprocket wheel d which is equipped in the usual manner with sprockets engaging with the perforations of the sound ribbon. The film g rests firmly on a part of the circumference of this roller corresponding to the distance between the pressure rollers e and f. The pulley h, which might also be a gear or other suitable means, and the rotary mass i, which imparts to the shaft and so to the roller d a uniform speed of rotation, are also connected with the shaft. Therefore the sound ribbon moves also with uniform speed e. g. in the direction f—e. These rollers e—f press the ribbon firmly against the roller d so that it rests on the whole length from f to e without shifting on account of the sprockets which engage with the perforations. The engaging and disengaging of the sprockets occurs under the pressure of the rollers f and e so that vibrations of the sound ribbon do not make themselves felt any longer at the point of projection. The free ends of the film g—g are preferably guided by prewinding rollers such as used in

moving picture projection so that they form a slight loop. For recording purposes where the rhythmically modulated light which is to be recorded needs to illuminate only the emulsion surface of the sound ribbon, a solid drum d can be employed on which the sound ribbon rests with its whole width.

For purposes of reproduction, where the light of the projection light source which has been concentrated into a narrow line by the objective n, is made to fall through the film on the light sensitive organ e. g. the cell k with the cathode l and the anode m, a drum of special design is required. d in the figure is an example of a construction in which the part of the ribbon which carries the sound record protrudes over the rim of the drum. The sound record may also lie between the two rows of perforations while only one row of perforations is used for driving and the other side of the sound ribbon runs along without being guided, or runs over an idle, resp. specially driven pulley with or without sprockets.

Patent Claims

1) Driving device for sound ribbons in accordance with patent of March 24th 1921 characterized by the fact that the sprocket wheel which moves the sound ribbon acts immediately at the point of projection.

2) Driving device according to claim 1) characterized by prewinding rollers which wind the free ends of the film before and after the sprocket wheel in a known manner.

3) Driving device according to claim 1) characterized by the fact that for purposes of reproduction that part of the sound ribbons which carries the sound record protrudes over the sprocket wheel, so that the pencil of light rays may fall unimpeded on the photoelectric organ.

PLAINTIFFS' EXHIBIT NO. 6.

BESCHEINIGUNG.

Die Herren Joseph Massolle und Dr. Joseph Engl in Berlin-Grunewald, sowie Hans Vogt in Berlin-Wilmersdorf haben im Deutschen Reiche ein Gesuch um ein Erfindungspatent für einen

"Antrieb für Tonfilme"
—Zusatz zum Patent 387 058—

am 23. Januar 1922 beim Reichspatentamt hinterlegt.

Das angeheftete Stück ist eine richtige und genaue Wiedergabe der ursprünglichen Unterlage dieser Patentanmeldung.

Berlin, den 3. März 1933.
Der Präsident des Reichspatentamts.
J. V.
LÜBCKE

(Reichspatentamt)

Gesehen zur Beglaubigung der vorstehenden Unterschrift.
Berlin, den 28. März 1933.

(Stempel)
21—5 RM

Das Auswärtige Amt des Deutschen Reichs.
Im Auftrag:

REIMKE
Reimke

Pat. 389 317.

C. R. Forth
Ingenieur

Tempelhof, den 21. Januar 1922.
Berlinerstr. 127.

F/Li
Zusatzanmeldung

Antrieb für Tonfilme.

Zusatz zum Patent ....(V. 15574 IX/42 g).

Gegenstand des Hauptpatentes .....(V. 15574 IX/42 g) ist eine Einrichtung, nach welcher ein Tonfilm bei seiner Fortschaltung mit einer Schwungmasse gekuppelt ist.

Bei der geringen Umdrehungszahl der Antriebswelle des Tonfilmes und starrem Antrieb genügt die Umfangsgeschwindigkeit von Schwungmassen, die sich praktisch noch verwenden lassen, jedoch nicht zur Kompensation der Geschwindigkeitsschwankungen.

Erfindungsgemäsz erfolgt deshalb der Antrieb der Schwungmassenachse mittels einer elastischen Kupplung, beispielsweise einer Feder. Diese kann sehr weich sein, da sie bei gleichbleibender Geschwindigkeit nur die Reibungsverluste des zu treibenden Teiles zu überwinden hat. Da jedoch beim An- und Auslaufen des Triebwerks die Trägheit der Schwungmasse überwunden werden musz, ist es vorteilhaft, das Spiel der Feder beiderseits durch einen festen Anschlag zu begrenzen.

Patentansprüche.

1.) Antrieb für Tonfilme nach Patent ..... (V. 15574 IX/42 g) gekennzeichnet durch einen Antrieb mit lastischer Kupplung.

2.) Ausführung nach Anspruch 1, gekennzeichnet durch beiderseitige Begrenzung der Kupplung (Feder) durch feste Anschläge.

AMERICAN CONSULAR SERVICE.

German Reich,
Province of Brandenburg,
Consulate General of the United States of America at Berlin. } ss.

I, Hugh Corby Fox Vice Consul of the United States of America at Berlin, German Reich, duly commissioned and qualified, do hereby certify that Lübcke whose true signature and official seal are, respectively, subscribed and affixed to the foregoing instrument, was at the time of subscribing same an official of the Government Patent Office of the German Reich, duly commissioned and by law authorized to execute such acts, and that his signature and official seal affixed thereto are genuine, and as such are entitled to full faith and credit.

IN WITNESS WHEREOF I have hereunto set my hand and the seal of the Consulate General at Berlin, German Reich, this 28th day of March 1933.

HUGH CORBY FOX,
Vice Consul of the United States
(Seal) of America.

Service No. 01938. $2.—Mk. 8.48.

(American Consulate General, Berlin, Germany. Rec'd March 28, 1933. $2.00 Fee Stamp.)

Translation.

CERTIFICATE

Messrs. Joseph Massolle and Dr. Joseph Engl of Berlin-Grunewald, as well as Hans Vogt of Berlin-Wilmersdorf have filed in the German Reich an application for an invention patent for a "Drive for Sound Films" Addition to Patent 387058 at the Reich's Patent Office on Jan. 23, 1922.

The attached sheet is a correct and accurate reproduction of the original document of this patent application.

Berlin, March 3rd, 1933

The President of the Reich's Patent Office

by

(signed) Lübcke

SEAL
Reich's Patent Office

SEAL
Foreign Office of the German Reich
(5 Reichsmark)

Seen for certification of the above signature Berlin, March 28th, 1933
The Foreign Office of the German Reich
by
(signed) Reimke

Patent 389317

Tempelhof,
Jan. 21st, 1922
Berliner Strasse 127

C. R. Forth
Engineer
F/Li

ADDITIONAL APPLICATION

DRIVE FOR SOUND FILMS

Addition to patent.....(V. 15574 IX/42g).
Object of the main patent....(V. 15574 IX/42g) is a device according to which a sound film is coupled with a rotational mass during its motion.

The peripheral speed of rotating masses, which can be still practically employed, is however not sufficient for the compensation of fluctuations in speed at the low number of revolutions of the driving shaft of the sound film and with a rigid drive.

Therefore according to the invention the shaft of the rotating mass is driven through an elastic coupling, e. g. a spring. This spring may be very soft, since at constant speed it has only to overcome the frictional losses of the part to be driven. Since however the inertia of the rotating mass has to be overcome during the starting and stopping of the driving mechanism, it is advantageous to limit the play of the spring on both sides by fixed stops.

PATENT CLAIMS.

1.) Drive for sound films according to patent (V. 15574 IX/42g) characterized by a drive with an elastic coupling.

2.) Construction according to claim 1, characterized by fixed stops to limit the coupling (spring) on both sides.

PLAINTIFFS' EXHIBIT NO. 7.

United States Patent No. 1,590,185.

270

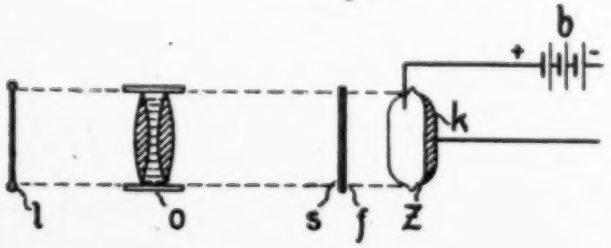
June 29, 1926. 1,590,185

J. ENGL ET AL

LIGHT SOURCE AND LIGHT SENSITIVE COATING FOR PHONOCINEMATOGRAPHY

Filed April 4, 1921

Fig. 2



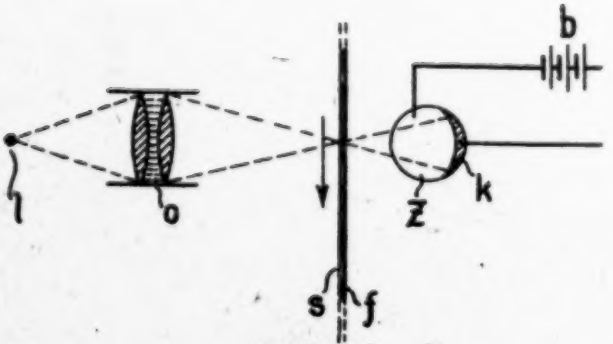
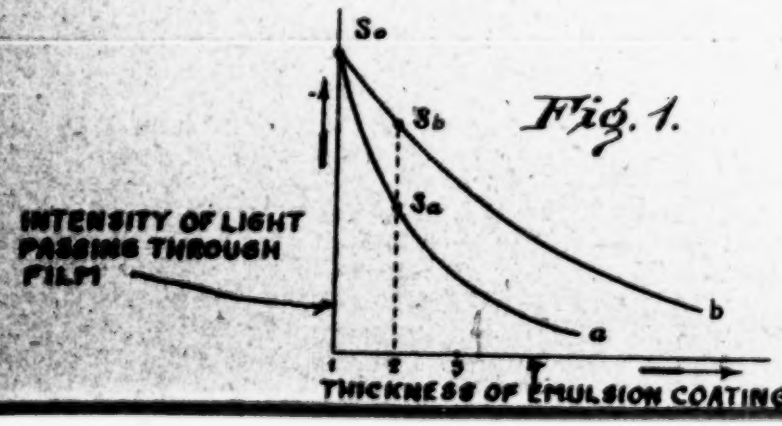


Fig. 3.

Fig. 1.



INVENTORS
Joseph Engl
Hans Vogt
Joseph Massolle
BY
Mimmie
ATTORNEYS

Patented June 29, 1926. 1,590,185

UNITED STATES PATENT OFFICE.

JOSEF ENGL, OF GRUNEWALD, HANS VOGT, OF BERLIN-SCHONEBERG, AND JOSEPH MASSOLLE, OF GRUNEWALD, GERMANY, ASSIGNORS TO TRI-ERGON LIMITED, OF ZURICH, SWITZERLAND.

LIGHT SOURCE AND LIGHT-SENSITIVE COATING FOR PHONOCINEMATOGRAPHY.

Application filed April 4, 1921, Serial No. 458,634, and in Germany December 23, 1919.

It is known to record by photography the intensities of sound from any source as variations of degree of blackening of, for instance, the silver bromide coating of a moving film. For the reproduction of such photophonograms an optico-electrical method is employed. A small portion of the film is illuminated by an intense source of light of suitable form. The light allowed to pass through the film in accordance with the photographical blackening is concentrated onto an electrical device, (photoelectric cell), in which it sets up electric currents whose strength is dependent upon the energy of radiation, received by the cell, that is to say, according to the degree of absorption of light by the silver bromide coating on the film. When the film moves past the cell an electric acoustically-modulated current is generated, in a circuit including the cell, which current can again be converted into sound waves.

According to the invention sources of light are used, whose light emission is so adapted to the absorption properties of the coating constituting the photophonogram that the fluctuations in the light radiations which impinge upon the photoelectrical device, and consequently the variations in amplitudes of the wave current produced in the circuit of the photoelectric cell, are as great as possible.

In accordance with the invention, also, the photoelectric cell is chosen so as to have maximum or desired sensitiveness to the wave-length of light principally emitted by the light source. The invention is predicated upon the use of a selective light source. that is, one which chiefly emits light of a certain range of wave-lengths, or rays of light at a desired part of the spectrum, and using therewith a film the coating of which is particularly absorptive of such rays; and also using with such source a light-responsive cell the cathode or light-sensitive element of which is particularly sensitive to such rays. This is based upon the observation that different forms of emulsion are absorptive of, or, conversely, are permeable by, different ranges of light wavelengths, to different extents; and also that

The effect of using with a particular selective light source, a coating on the film of maximum absorption properties for the light from that source, is to produce greater variations of light acting upon the photocell, and greater changes in amplitude of current produced by the cell, and more distinct changes of intensity of sound finally produced by the said fluctuating current, than if the light source and emulsion coating were not thus related to each other. The effect of using, with said selective light source, a photo-cell of greatest sensitiveness for the light emitted by that cell, is to give greater amplitude to the current produced by the cell, and therefore greater intensity of sound finally produced, than if the source and cell were not thus related to each other.

In the accompanying drawings, Figure 1 is a diagram wherein the manner of the absorption of two different radiations for varying thicknesses of the film emulsion coating is represented by curved lines, the horizontal co-ordinate of the diagram representing the thickness of the light-absorbing layer on the film, and the vertical co-ordinate representing the intensity of light allowed to pass through the film; and

Figs. 2 and 3 are diagrammatical views, each showing the apparatus in connection with which the present invention may be employed, Fig. 3 being taken at right angles to Fig. 2.

It will be understood that the photographic sound record formed on the emulsion coating of the film varies in intensity, that is to say, by variation in density or thickness of the emulsion coating corresponding to variations of intensity of the original sound which is photographically recorded on the film.

The manner in which emulsion coatings vary in light absorptive properties when subjected to radiations of different characters is illustrated in the diagram Figure 1. If the thickness of the emulsion coating on the film increases, for example, from value one to value two in the diagram, the amount of light from one radiation source which passes through the emulsion coating decreases, as the thickness of the coating in-

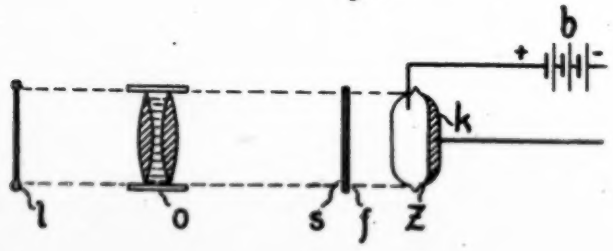
June 29, 1926. 1,590,185

J. ENGL ET AL

LIGHT SOURCE AND LIGHT SENSITIVE COATING FOR PHONOCINEMATOGRAPHY

Filed April 4, 1921

Fig. 2



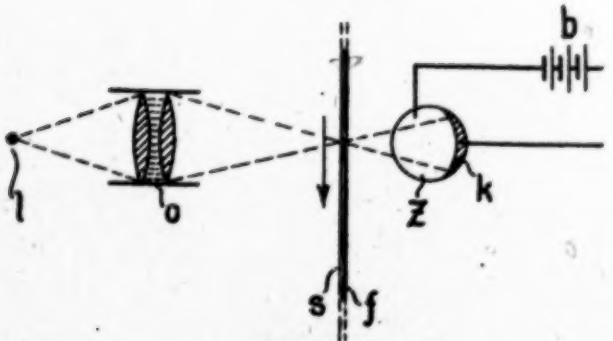
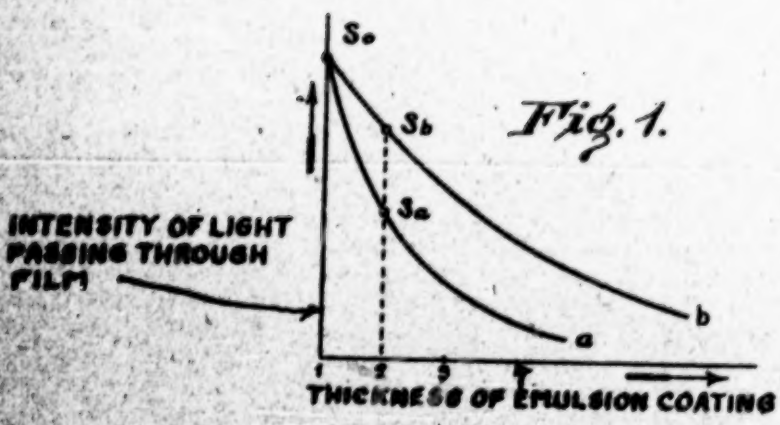


Fig. 3.

Fig. 1.



INVENTORS
Joseph Engl
Hans Vogt
Joseph Massolle
BY
Mumm & Co.
ATTORNEYS

UNITED STATES PATENT OFFICE.

JOSEF ENGL, OF GRUNEWALD, HANS VOGT, OF BERLIN-SCHONEBERG, AND JOSEPH MASSOLLE, OF GRUNEWALD, GERMANY, ASSIGNORS TO TRI-ERGON LIMITED, OF ZURICH, SWITZERLAND.

LIGHT SOURCE AND LIGHT-SENSITIVE COATING FOR PHONOCINEMATOGRAPHY.

Application filed April 4, 1921, Serial No. 458,634, and in Germany December 22, 1919.

It is known to record by photography the intensities of sound from any source as variations of degree of blackening of, for instance, the silver bromide coating of a moving film. For the reproduction of such photophonograms an optico-electrical method is employed. A small portion of the film is illuminated by an intense source of light of suitable form. The light allowed to pass through the film in accordance with the photographical blackening is concentrated onto an electrical device, (photoelectric cell), in which it sets up electric currents whose strength is dependent upon the energy of radiation, received by the cell, that is to say, according to the degree of absorption of light by the silver bromide coating on the film. When the film moves past the cell an electric acoustically-modulated current is generated, in a circuit including the cell, which current can again be converted into sound waves.

According to the invention sources of light are used, whose light emission is so adapted to the absorption properties of the coating constituting the photophonogram that the fluctuations in the light radiations which impinge upon the photoelectrical device, and consequently the variations in amplitudes of the wave current produced in the circuit of the photoelectric cell, are as great as possible.

In accordance with the invention, also, the photoelectric cell is chosen so as to have maximum or desired sensitiveness to the wave-length of light principally emitted by the light source. The invention is predicated upon the use of a selective light source, that is, one which chiefly emits light of a certain range of wave-lengths, or rays of light at a desired part of the spectrum, and using therewith a film the coating of which is particularly absorptive of such rays; and also using with such source a light-responsive cell the cathode or light-sensitive element of which is particularly sensitive to such rays. This is based upon the observation that different forms of emulsion are absorptive of, or, conversely, are permeable by, different ranges of light wave-lengths, to different extents; and also that the light-sensitive materials possible for use in the photo-cell are sensitive to different light wave-lengths to different extents.

The effect of using with a particular selective light source, a coating on the film of maximum absorption properties for the light from that source, is to produce greater variations of light acting upon the photo-cell, and greater changes in amplitude of current produced by the cell, and more distinct changes of intensity of sound finally produced by the said fluctuating current, than if the light source and emulsion coating were not thus related to each other. The effect of using, with said selective light source, a photo-cell of greatest sensitiveness for the light emitted by that cell, is to give greater amplitude to the current produced by the cell, and therefore greater intensity of sound finally produced, than if the source and cell were not thus related to each other.

In the accompanying drawings, Figure 1 is a diagram wherein the manner of the absorption of two different radiations for varying thicknesses of the film emulsion coating is represented by curved lines, the horizontal co-ordinate of the diagram representing the thickness of the light-absorbing layer on the film, and the vertical co-ordinate representing the intensity of light allowed to pass through the film; and

Figs. 2 and 3 are diagrammatical views, each showing the apparatus in connection with which the present invention may be employed, Fig. 3 being taken at right angles to Fig. 2.

It will be understood that the photographic sound record formed on the emulsion coating of the film varies in intensity, that is to say, by variation in density or thickness of the emulsion coating corresponding to variations of intensity of the original sound which is photographically recorded on the film.

The manner in which emulsion coatings vary in light absorptive properties when subjected to radiations of different characters is illustrated in the diagram Figure 1. If the thickness of the emulsion coating on the film increases, for example, from value one to value two in the diagram, the amount of light from one radiation source which passes through the emulsion coating decreases, as the thickness of the coating increases, according to the curve b from value S_1 to S_2, and for another source of light, according to curve a, from S_1 to S_2. By

the selection of a source of light whose radiation, corresponding to curve *a*, has a high co-efficient of absorption in the emulsion coating of the photophonogram carrier, it is thus possible to make the varying amplitudes of the wave current to be converted into acoustic waves, as great as possible. That is to say, the increased variations of amplitude of the fluctuating current produced by the photoelectric cell are thus increased by the conjoint use of a source of light, the rays chiefly emitted by which are of a particular character, with an emulsion coating on the film which is particularly absorptive of such rays.

In order that the effect of the radiation through the emulsion coating, upon the photoelectric cell or other light sensitive device, shall be as large as possible, the photoelectric device is chosen with absorption properties which are dependent upon the nature of the light source, since the sensitivity to light of such devices, throughout a considerable range of wave-lengths, can be adjusted to certain wave-lengths. That is to say, a current of maximum strength will be provided by the photoelectric device or light responsive device used, the light sensitive element of which has maximum sensitiveness for the rays chiefly emitted by the particular source of light used.

The invention can be practiced in various ways. For example, for the source of light, a mercury vapor lamp may be used in which the vapor is rendered luminous by the passage of an electric current therethrough. This lamp may be the intensely luminous quartz lamp, known in science for other purposes, in which the major portion of the radiation intensity is located at the short wave boundary of the visible spectrum and within the ultra violet range. With such a light source, a photoelectric cell should be used, the maximum sensitivity of which lies within this portion of the spectrum, for instance an alkali photoelectric cell having a cathode of metallic sodium.

If an emulsion coating of silver of varying permeability be used as represented for instance by a film having a photographic imprint which has been developed, the absorptivity of the thin silver coating is minimum for light rays of wave-lengths corresponding to the violet and ultra violet end of the spectrum. Because silver coatings are particularly permeable for light of such wave-lengths, they are replaced in accordance with this invention by emulsion coatings of mercury or copper, for example when the light source is a mercury vapor lamp. Therefore, in this example the light source emits largely the ultra violet rays, which pass most the photo cell has maximum sensitivity for such rays.

In the selection of the source of light it must further be taken into consideration that it is desirable to filter out all the radiation energy other than the rays for which the particular light source is selected. That is to say, in the above example the infra red and the rest of the visible radiations may be screened out by the provision of suitable light filters located between the source of light and the film, since this portion of the light emitted by the source is unnecessary and may render the technical solution of the problem of reproducing sound vibrations impossible. For this reason and also on account of the well known spectral selectivity of the photoelectric device, it is generally of advantage to use sources of light, the radiation of which has a selective character. Radiating bodies which possess a continuous emission spectrum, such as heated solid bodies (metallic wires, Nernst glowers, incandescent carbon electrodes of the light arc, etc.) are therefore less suitable. Light sources with selective radiation are, for example, metallic vapors which have been rendered luminous by an electric discharge of currents of high intensity. Selective light sources which may thus be used are mercury, cadmium and zinc lamps, which are well known in the technical arts for other uses. A cadmium vapor lamp, for instance, might be used with a photoelectric cell having a cathode of rubidium as the photoelectric element of maximum sensitivity for use with this particular light source. The cadmium lamp chiefly produces red rays and the rubidium cell may be used with it since it is most sensitive to the red rays. A film coating of maximum absorptivity for these red rays should, of course be used.

We claim:

1. In sound reproducing apparatus, the combination of a source of light, a light-sensitive cell, and a transparent film having a sensitive emulsion coating thereon, movable between the light-source and cell said coating having a photographic sound record of varying light-permeability formed thereon; said source being adapted to emit rays of greatest intensity at one part of the spectrum, said cell having a light-sensitive element which is most sensitive to such rays, and the coating on the film being of such character as to be more absorptive of such rays than of light rays at other parts of the spectrum.

2. In sound reproducing apparatus, the combination of a source of light, a light-sensitive cell, and a transparent film having a sensitive emulsion coating thereon.

thereon; said source being a luminous metallic vapor having a spectral selectivity such that it chiefly emits light rays belonging to only one part of the spectrum, said cell having a light sensitive element which is most sensitive to such rays, and the coating on the film being of such character as to be more absorptive of such rays than of light rays at other parts of the spectrum.

3. In sound reproducing apparatus, the combination of a source of light, a light-sensitive cell, and a transparent film having a sensitive emulsion coating thereon, movable between the light-source and cell, said coating having a photographic sound record of varying light-permeability formed thereon; said source being a luminous metallic vapor lamp having a spectral selectivity such that it chiefly emits light rays at the short wave end of the visible spectrum and in the ultra violet region, said cell having an alkali cathode which is most sensitive to said rays, and the coating on the film being a layer of mercury, adapted to be more absorptive of such rays than of light rays at other parts of the spectrum.

4. In sound reproducing apparatus, the combination of a source of light, a light-sensitive cell, and a transparent film having a sensitive emulsion coating thereon, movable between the light-source and cell, said coating having a photographic sound record of varying light-permeability formed thereon; said source being a mercury vapor lamp emitting rays of greatest intensity at the short wave end of the visible spectrum and in the ultra-violet region, said cell having a sodium cathode, and the coating on the film comprising a layer of mercury.

5. In sound reproducing apparatus, the combination of a light source of spectral selectivity such that it chiefly emits light rays belonging to only one part of the spectrum, a photo-cell, and a transparent film movable between the light-source and cell and light filtering means between said source and film for screening out rays of the other wave-lengths than those chiefly emitted by said source, said film having a sensitive emulsion coating thereon having a photographic sound record in which varying intensities of sound are represented by lines or portions of correspondingly varying density or thickness of emulsion, said emulsion coating being of such character as to be more absorptive of rays of the wave-lengths chiefly emitted by said source than of light rays at other parts of the spectrum.

6. A process of reproducing sound, comprising, selecting a source of light of spectral selectivity such that it emits light rays of greatest intensity at a desired part of the spectrum, selecting a film for a photographic sound record having an emulsion coating of such a character as to be more absorptive of rays of the wave-lengths chiefly emitted by said source than of light-rays at other parts of the spectrum, producing on such film a photographic sound record in which varying intensities of sound are represented by lines or portions of correspondingly varying density or thickness of emulsion, and selecting a photoelectric cell having a light sensitive element which is most sensitive to such rays, progressing said film between said source and said cell so that light from said source will pass through said film to greater or less degree and fall upon the light sensitive element of said cell, said cell being connected in a circuit in which a sound modulated current will flow, and causing such current to reproduce the sound.

In testimony whereof we affix our signatures.

DR. JOSEF ENGL.
HANS VOGT.
JOSEPH MASSOLLE.

the selection of a source of light whose radiation, corresponding to curve *a*, has a high co-efficient of absorption in the emulsion coating of the photophonogram carrier, it is thus possible to make the varying amplitudes of the wave current to be converted into acoustic waves, as great as possible. That is to say, the increased variations of amplitude of the fluctuating current produced by the photoelectric cell are thus increased by the conjoint use of a source of light, the rays chiefly emitted by which are of a particular character, with an emulsion coating on the film which is particularly absorptive of such rays.

In order that the effect of the radiation through the emulsion coating, upon the photoelectric cell or other light sensitive device, shall be as large as possible, the photoelectric device is chosen with absorption properties which are dependent upon the nature of the light source, since the sensitivity to light of such devices, throughout a considerable range of wave-lengths, can be adjusted to certain wave-lengths. That is to say, a current of maximum strength will be provided by the photoelectric device or light responsive device used, the light sensitive element of which has maximum sensitiveness for the rays chiefly emitted by the particular source of light used.

The invention can be practiced in various ways. For example, for the source of light, a mercury vapor lamp may be used in which the vapor is rendered luminous by the passage of an electric current therethrough. This lamp may be the intensely luminous quartz lamp, known in science for other purposes, in which the major portion of the radiation intensity is located at the short wave boundary of the visible spectrum and within the ultra violet range. With such a light source, a photoelectric cell should be used, the maximum sensitivity of which lies within this portion of the spectrum, for instance an alkali photoelectric cell having a cathode of metallic sodium.

If an emulsion coating of silver of varying permeability be used as represented for instance by a film having a photographic imprint which has been developed, the absorptivity of the thin silver coating is minimum for light rays of wave-lengths corresponding to the violet and ultra violet end of the spectrum. Because silver coatings are particularly permeable for light of such wave-lengths, they are replaced in accordance with this invention by emulsion coatings of mercury or copper, for example when the light source is a mercury vapor lamp. Therefore, in this example the light source emits largely the ultra violet rays, which pass most easily through the quartz glass of the lamp; the film coating has maximum absorption properties for such rays and the cathode of the photo cell has maximum sensitivity for such rays.

In the selection of the source of light it must further be taken into consideration that it is desirable to filter out all the radiation energy other than the rays for which the particular light source is selected. That is to say, in the above example the infra red and the rest of the visible radiations may be screened out by the provision of suitable light filters located between the source of light and the film, since this portion of the light emitted by the source is unnecessary and may render the technical solution of the problem of reproducing sound vibrations impossible. For this reason and also on account of the well known spectral selectivity of the photoelectric device, it is generally of advantage to use sources of light, the radiation of which has a selective character. Radiating bodies which possess a continuous emission spectrum, such as heated solid bodies (metallic wires, Nernst glowers, incandescent carbon electrodes of the light arc, etc.) are therefore less suitable. Light sources with selective radiation are, for example, metallic vapors which have been rendered luminous by an electric discharge of currents of high intensity. Selective light sources which may thus be used are mercury, cadmium and zinc lamps, which are well known in the technical arts for other uses. A cadmium vapor lamp, for instance, might be used with a photoelectric cell having a cathode of rubidium as the photoelectric element of maximum sensitivity for use with this particular light source. The cadmium lamp chiefly produces red rays and the rubidium cell may be used with it since it is most sensitive to the red rays. A film coating of maximum absorptivity for these red rays should, of course be used.

We claim:

1. In sound reproducing apparatus, the combination of a source of light, a light-sensitive cell, and a transparent film having a sensitive emulsion coating thereon, movable between the light-source and cell said coating having a photographic sound record of varying light-permeability formed thereon; said source being adapted to emit rays of greatest intensity at one part of the spectrum, said cell having a light-sensitive element which is most sensitive to such rays, and the coating on the film being of such character as to be more absorptive of such rays than of light rays at other parts of the spectrum.

2. In sound reproducing apparatus, the combination of a source of light, a light-sensitive cell, and a transparent film having a sensitive emulsion coating thereon, movable between the light-source and cell, said coating having a photographic sound record of varying light-permeability formed

thereon; said source being a luminous metallic vapor having a spectral selectivity such that it chiefly emits light rays belonging to only one part of the spectrum, said cell having a light sensitive element which is most sensitive to such rays, and the coating on the film being of such character as to be more absorptive of such rays than of light rays at other parts of the spectrum.

3. In sound reproducing apparatus, the combination of a source of light, a light-sensitive cell, and a transparent film having a sensitive emulsion coating thereon, movable between the light-source and cell, said coating having a photographic sound record of varying light-permeability formed thereon; said source being a luminous metallic vapor lamp having a spectral selectivity such that it chiefly emits light rays at the short wave end of the visible spectrum and in the ultra violet region, said cell having an alkali cathode which is most sensitive to said rays, and the coating on the film being a layer of mercury, adapted to be more absorptive of such rays than of light rays at other parts of the spectrum.

4. In sound reproducing apparatus, the combination of a source of light, a light-sensitive cell, and a transparent film having a sensitive emulsion coating thereon, movable between the light-source and cell, said coating having a photographic sound record of varying light-permeability formed thereon; said source being a mercury vapor lamp emitting rays of greatest intensity at the short wave end of the visible spectrum and in the ultra-violet region, said cell having a sodium cathode, and the coating on the film comprising a layer of mercury.

5. In sound reproducing apparatus, the combination of a light source of spectral selectivity such that it chiefly emits light rays belonging to only one part of the spectrum, a photo-cell, and a transparent film movable between the light-source and cell and light filtering means between said source and film for screening out rays of the other wave-lengths than those chiefly emitted by said source, said film having a sensitive emulsion coating thereon having a photographic sound record in which varying intensities of sound are represented by lines or portions of correspondingly varying density or thickness of emulsion, said emulsion coating being of such character as to be more absorptive of rays of the wave-lengths chiefly emitted by said source than of light rays at other parts of the spectrum.

6. A process of reproducing sound, comprising, selecting a source of light of spectral selectivity such that it emits light rays of greatest intensity at a desired part of the spectrum, selecting a film for a photographic sound record having an emulsion coating of such a character as to be more absorptive of rays of the wave-lengths chiefly emitted by said source than of light-rays at other parts of the spectrum, producing on such film a photographic sound record in which varying intensities of sound are represented by lines or portions of correspondingly varying density or thickness of emulsion, and selecting a photoelectric cell having a light sensitive element which is most sensitive to such rays, progressing said film between said source and said cell so that light from said source will pass through said film to greater or less degree and fall upon the light sensitive element of said cell, said cell being connected in a circuit in which a sound modulated current will flow, and causing such current to reproduce the sound.

In testimony whereof we affix our signatures.

DR. JOSEF ENGL.
HANS VOGT.
JOSEPH MASSOLLE.

PLAINTIFFS' EXHIBIT NO. 8.

Certified Copy of File Wrapper and Contents, Vogt, et al., U. S. Application Ser. No. 458,626, Filed April 4, 1921.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 9.

Certified Copy and Translation, Vogt, et al., German Application of March 3, 1919.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 10.

FILED DEC 9 1931 FRANK E. CUNNINGHAM, CLERK
IN THE SUPREME COURT OF THE DISTRICT OF COLUMBIA

AMERICAN TRI-ERGON CORPORATION et al —VS— THOMAS E. ROBERTSON Commissioner of Patents	IN EQUITY No. 47904.

The Court makes and files the following Findings of Fact and Conclusions of Law—

FINDINGS OF FACT.

1. Plaintiffs Josef Engel, Hans Vogt and Joseph Massolle, citizens and residents of Germany, filed in the German Patent Office on March 3, 1919 an application for German Letters Patent which described and claimed as their invention certain sound recording and reproducing apparatus (copy of a translation thereof is made part hereof by reference).

Plaintiffs duly filed their patent application involved herein in the United States Patent Office on the subject matter of said German application on April 4, 1921, Serial No. 458,626 (copy thereof is made part hereof by reference), said applicants having assigned said application to plaintiffs American Tri-Ergon Corporation and Tri-Ergon Holding A. G., as set forth in the amendments to the bill of complaint. Inventor plaintiffs hereafter will be referred to as plaintiffs.

Defendant has accepted said United States application as coming under the provisions of the "Nolan

Act" (March 3, 1921, chapter 126, sec. 1, 41 Stat. L. 1313; U. S. C. Title 35, sec. 80), and as being based upon said German application of March 3, 1919, and as being entitled to said last date as its effective date, under the provisions of said Act. Said United States application is entitled to the date of March 3, 1919 as its effective date.

The amendments to said United States application as originally filed, as to description, claims, and the addition of drawings, have been accepted by the Primary Examiner of the Patent Office and made part of the application, as being justified by and in accordance with the disclosure in said application as originally filed. The same are made part hereof by reference.

2. The invention upon which plaintiffs (including assignee plaintiffs) seek the grant of a patent on said United States application is defined by the following claims:

> 1. In sound reproducing apparatus, the combination of a photoelectric cell having an alkali cathode, means for illuminating the cell with acoustically-modulated light, and a circuit connected with said cell in which flows a correspondingly modulated current.
>
> 2. In sound reproducing apparatus, the combination of a photoelectric cell having an alkali cathode, a constant source of light, means for uniformly progressing a film between said source and cell, said film carrying a photographic sound record of varying opacity, so that said cell is illuminated by acoustically-modulated light, which has passed through the film, and a circuit connected with said cell in which flows a correspondingly modulated current.

3. In sound reproducing apparatus, the combination of a photoelectric cell having an alkali cathode, means for illuminating the cell with acoustically-modulated light, an amplifier, a circuit connecting said cell with said amplifier, a sound reproducing device, and a circuit connecting said amplifier with said sound reproducing device.

4. In sound reproducing apparatus, the combination of a photoelectric cell having an alkali cathode, means for illuminating the cell with acoustically-modulated light, an amplifier a circuit connecting said cell with said amplifier, and a circuit connected with said amplifier, in which flows amplified currents which vary correspondingly with the variations of said acoustically-modulated light.

The sound reproducing apparatus disclosed in said United States application and covered by said claims operates as follows—A photographic film record is used which carries a variegated series of blackened areas produced thereon by acoustically-modulated light, and representing the sound thereon recorded. In reproducing sound from this record the film is advanced past a photoelectric cell and a beam of light from a constant source is projected against and through said successive areas on said film known as the sound track. The blackened areas thereon thus cause the light passing therethrough to be acoustically-modulated in accordance with the recorded sound. This modulated light is directed on to the photoelectric cell which is provided with an alkali cathode (i. e. a cathode formed for example of an alkali hydride). In response to such light certain electronic emissions from the cathode cause feeble currents to

flow through the cell and the circuits in which it is connected. These currents vary accurately in accordance with the variations of the light. Suitable electrical connecting circuits are provided from the electrodes of the photoelectric cell for applying these feeble current variations, without distortion, to intensifying or amplifying means. Amplified electrical currents varying accurately in accordance with the recorded sound variations are thereby produced, free from lag, inertia or other distortion effects, and made available for proper operation of an auditorium loud speaker or other telephone device.

3. Patents have been granted on plaintiffs' invention here involved in Great Britain, Canada, Germany, Holland, Norway and Switzerland, and in other countries.

4. Plaintiffs on this record were the first to investigate the properties and functioning of a photoelectric cell as applied to the special requirements of sound reproduction, and to determine that said cell when suitably connected could be made to function so as to meet these special requirements. Plaintiffs in September, 1922 in Berlin, Germany, gave the first public demonstrations in the world of talking motion picture films utilizing photoelectric reproduction of sound. The reproducing apparatus used in said demonstrations embodied the invention here involved. Private demonstrations were given by plaintiffs in 1919, also with apparatus embodying said invention.

5. The photoelectric cell, as embodied in the invention here involved, is the type of light sensitive cell now in general use for the reproduction of sound from film records, though during the years which have elapsed since plaintiffs' invention there have been de-

velopment and improvement over the forms of the photoelectric cell known at the time of plaintiffs' invention.

6. For many years prior to the time of plaintiffs' invention here in issue the selenium cell had often been suggested as a light sensitive means for translating acoustically modulated light rays into electric current variations for sound reproduction. From time to time and until plaintiffs' invention was made known to the world various patents and publications had issued, directed to apparatus and methods of reproducing sound by projecting light through a variably blackened strip on to light sensitive cells of the selenium type, and that up to the time plaintiffs' invention was made known to the public the selenium cell was considered to be the best available instrument for translating light variations into electrical current for sound reproduction purposes. Sound reproduction apparatus utilizing selenium cells had not proven to be scientifically satisfactory, nor of commercial use.

7. Prior to the time of plaintiffs' invention here involved there had been no known use of photoelectric cells in sound reproduction, and there was no scientific data which showed—and it was not known—that said cells possessed the necessary properties to meet and were capable of functioning so as to meet the special requirements of sound reproduction.

The construction of photoelectric cells having an alkali cathode—the kind of cell used by plaintiffs—was *per se* known in the art as a light sensitive device as early as about 1894 (but not as a device useful for sound reproduction).

At the time of plaintiffs' invention here involved there had never been commercial use of photoelectric cells, and all known actual uses of the same had been

confined to laboratory photometric measurements, i. e., measurements of light emitted by lamps and the measurement of star light.

At the time of plaintiffs' invention there was so little knowledge of photoelectric cells, and so little use therefor that they could not be purchased on the market as an article of commerce, and it was necessary for research workers desiring to experiment with these cells to have the necessary equipment to make and to painstakingly make and test out the same, or else have them made in especially well equipped laboratories.

8. Sound waves embody highly complex vibrations of widely different intensities and frequencies and therefore any light sensitive cell used in reproducing the sound must meet severe requirements.

The essential requirements of any light-responsive cell (i. e. such as the photoelectric cell) illuminated by acoustically modulated light for the control of an electric circuit in the successful reproduction of sound, include the following characteristics:

(a) The current variations set up in the cell when illuminated by the acoustically modulated light should be responsive synchronously with the impinging light, i. e., without lag of the current in response to illumination and without persistence of the current after the illumination is decreased or discontinued, and this requirement should be maintained throughout the range of important sound frequencies (i. e. from approximately 30 variations per second to approximately 10,000 variations per second).

(b) The said variations of the cell current should be directly proportional to variations of the acoustically-modulated light, i. e., a so-called "linear" or "straight line" relationship should

prevail between the impinging light and the resulting cell current, throughout the important range of sound frequencies and for all sounds of varying intensities.

(c) The cells should be free of any fatigue characteristics, i. e., the sensitivity of a cell should remain substantially permanently constant regardless of the intensities, frequencies, and duration of the acoustically modulated light impinging upon the cell.

9. That selenium cells are seriously lacking in respect to all of said requirements for sound reproduction.

That sound reproduction apparatus utilizing selenium cells has never been successful, for various reasons including the following—

(a) The current response to light in selenium cells, as known prior to the invention here in issue, was very erratic under different conditions and circumstances of use.

(b) The current response to light in selenium cells involves serious and variable "lag" and "persistence" characteristics which greatly distort sound modulated currents.

(c) There is no "linear" or "straight line" relationship between the selenium cell current and the impinging light.

(d) Selenium cells have fatigue characteristics which distort sound modulated currents.

The shortcomings of selenium cells, mentioned in this Finding, are present with all of the selenium cell systems disclosed or suggested in defendant's exhibits.

10. Prior to the time of plaintiffs' invention herein involved it had not been determined that photoelectric cells possessed any of the above stated essential characteristics for satisfying the requirements of sound reproduction. Plaintiffs by their work in 1918 and 1919 were the first to investigate and demonstrate that photoelectric cells possessed such characteristics as to meet each of the above stated requirements.

11. The current flowing through photoelectric cells in use is of the order of magnitude of one millionth (1/1,000,000) ampere.

Prior to the time of plaintiffs' invention the minute photoelectric cell currents had been measured only with sensitive galvanometers or electrometers, which involved moving parts so sluggish in their response that such instruments could not reveal or demonstrate whether photoelectric cells had any of the above stated necessary characteristics for responding to the frequencies of sound reproduction.

It was necessary for plaintiffs to devise and construct special apparatus with which to determine that photoelectric cells possess the above stated necessary charactersitics for sound reproduction, no such apparatus being previously known.

Prior to the time of the work done by plaintiffs on their invention here involved there was no accurate sound record available with which to test the adaptability of photoelectric cells to the reproduction of sound, and it was necessary for plaintiffs to devise an improvised record with which to test the adaptability of photoelectric cells in responding to light variations of the various intensities and frequencies throughout the audible sound range.

12. Plaintiffs were the first to definitely confirm their scientific demonstrations that photoelectric cells

in actual practice are able to meet all of the several requirements for sound reproduction.

13. Prior to the time of plaintiffs' invention here involved—

> Published scientific data and opinions of leading scientists were in conflict as to the nature of the current response in photoelectric cells resulting from variations of light of even low or gradually changing frequencies, and the facts as to whether photoelectric cells possessed lag characteristics, lack of the "linear relationship" and fatigue characteristics, even with slow frequencies, were all unknown or disputed questions among reputable physicists.
>
> Nothing was known in the art as to the ability of photoelectric cells to properly respond to light variations of the frequencies of sound modulated light.

The prior efforts of others to use photoelectric cells for photometric measurements and measurements of star light gave no indication of the adaptability of such cells for sound reproduction because such measurements involved no such high and widely variable frequencies and widely variable intensities as encountered in sound reproduction.

14. The currents from photoelectric cells as known in the prior art were so feeble that they would have been scarcely audible if a telephone had been connected to the cell without amplifying means. The circuits shown in the prior art connecting selenium cells with amplifying means for sound reproduction would be inoperative as connections between photoelectric cells and amplifying means for sound reproduction.

Prior to plaintiffs' invention here in issue vacuum tube amplifiers for amplifying electric currents for various uses were well known but the prior art fails to disclose that electrical connections were known in the art for connecting such amplifiers up with photoelectric cells so as to produce distortion free amplification of sound modulated currents from photoelectric cells, which cells produce infinitesimal currents.

Leading scientists working on the problem of amplifying photoelectric cell currents during and shortly before and after the period of plaintiffs' work on the invention here at issue appreciated and encountered difficulties which were then insurmountable by them in amplifying photoelectric cell currents sufficiently for any practical uses.

15. Plaintiffs were the first to devise suitable electrical connections between photoelectric cells and amplifiers for the amplification of acoustically modulated photoelectric cell currents.

The circuit described in the specification of plaintiffs' application and shown in Fig. 3 of the drawings thereof constitute one of the suitable circuits devised by them for connecting a photoelectric cell as used for sound reproduction to an amplifier.

16. The Fritts patent No. 1,203,190 of 1916 (applied for in 1880) refers to approximately 25 separate sound recording and reproducing devices and systems, none of which are commercially operative.

This patent refers to the use of the selenium cell in a circuit directly in series with a telephone device and battery, and with such an arrangement any sounds from the telephone could be barely audible.

Application for this patent was filed long before the photoelectric cell was known, and the patent does not mention that cell.

This patent discloses no circuit arrangements in which a photoelectric cell could have been substituted for the other cells referred to therein, and any such substitution would have increased many fold the difficulties of operating the Fritts apparatus even in 1916 when it issued.

This patent suggests no operative type of amplifier.

17. The British Patent to Polyphos, No. 3701 of 1908 relates to the electrical transmission of pictures and makes no reference to sound reproduction.

This patent suggests the substitution of the photoelectric cell for the selenium cell in picture transmission, but fails to disclose any circuit arrangements for making such a substitution possible, and at no time prior to March 3, 1919 were any circuit connections known in the art by which a photoelectric cell could have been used even for picture transmission.

18. The arts of picture transmission and sound reproduction are non-analogous, and a suitable light-sensitive cell for picture transmission might be totally unsuitable for sound reproduction for the following reasons—

(a) Picture transmission involves the use of continuous and slowly varying currents of frequencies less than a few hundred cycles per second, whereas sound reproduction involves rapidly varying currents of frequencies between approximately 30 and 10,000 cycles per second, frequencies lower than 30 cycles and slowly varying currents being inaudible in sound reproduction apparatus.

(b) The wave form of sound reproduction currents involves complex and highly variable combinations of frequencies and intensities not met with in picture transmission.

(c) The light sensitive cell in picture transmission constitutes part of the transmitting station apparatus, whereas in sound reproduction the light-sensitive cell is at the opposite end of the system, i. e. sound reproduction apparatus is comparable to the picture receiving rather than transmitting apparatus.

19. The Polyphos patent teaches that photoelectric cells do not possess the "linear" or "straight line" response characteristic necessary for light sensitive cells in sound reproduction. The specification of the patent incorrectly asserts that in photoelectric cells the "increase" of current is proportional to the intensity of illumination, and if this assertion were correct the photoelectric cell would not be useful for sound reproduction. The disclosures of the patent suggest to one skilled in the art that a photoelectric cell would not have the proper characteristics for sound reproduction, and the patent therefore does not suggest or teach the invention at issue.

At the time of the Polyphus patent galvanometers were used in picture transmission apparatus which gave nonlinear indications which were of such a nature that if used with these cells they would tend to compensate for the nonlinear response characteristic which this specification incorrectly attributes to the photoelectric cell.

20. At the time of the Polyphos patent and subsequently inventors in the picture transmission art were seeking to overcome the slow lag or drift characteristic of selenium cells as used in that art, but the inability of the selenium cell to respond to frequencies of the range of audible sound was not appreciated and gave no concern to inventors in the picture transmission art.

The suggestions given by Polyphos for avoiding the lag in selenium cells (i. e. the above mentioned slow lag or drift) involved no suggestion advancing the art of sound reproduction.

21. The patent to Hull, No. 1,313,187 (applied for in 1915 and granted August 12, 1919) is directed to an amplifying means which is illustrated in connection with a photoelectric cell, but it makes no reference to sound reproduction, and the arrangements shown therein are unsuitable for sound reproduction, and have never been used for such purpose for the following reasons—

(a) Amplification by this arrangement is limited to a ratio of 1000 to 1, and the practical limit is much lower, which ratio is entirely too low for sound reproduction with photoelectric cells.

(b) This arrangement when used for the amplification of photoelectric cell currents requires the current supply to be kept constant within a degree far exceeding commercially practical limits and therefore for such purpose the arrangement is extremely unstable.

(c) The amplified photoelectric cell currents with this arrangement would not be proportional to the current before amplification except within a range too small for sound reproduction purposes.

This patent does not disclose the use of any sound reproducing instrumentality, and the substitution of any such sound device for sound reproduction in lieu of the indicator shown in the patent would render the circuit completely inoperative.

22. The "Physical Review" article (Deft. Ex. D) refers to an amplifier arrangement for photoelectric

cells as used in photometric measurements, and makes no reference to sound reproduction, and does not disclose or suggest the use of any audible indicating instrument. Sound reproduction currents if amplified by this arrangement would be distorted to a very marked degree, and weak currents would be amplified to a much greater degree than strong currents.

Amplification by this arrangement is limited to a ratio of approximately 1000 to 1, which would be of no use for sound reproduction.

23. The patent to Langmuir, No. 1,273,627 of July. 1918, is directed to an amplifying means which is illustrated in connection with a photoelectric cell but no reference is made therein to sound reproduction.

The amplifier shown is adapted for use with direct and slowly varying currents, and is not adapted to use for amplification of sound-modulated currents.

24. The patent to Stocks, No. 1,252,905 of 1918 refers to a sound reproducing apparatus utilizing a selenium cell in connection with a suggested form of amplifier, but the amplifier suggested is of a radical and inoperative type which actually causes a decrease rather than any increase of the current. None of the difficulties of using a selenium cell for sound reproduction as hereinabove stated are overcome in this patent.

25. The French patent to Gabrie, No. 456,880 of 1913, fails to disclose or suggest any way in which a photoelectric cell could be used for sound reproduction, and fails to disclose any circuit connections for photoelectric cells, and fails to disclose any advantage in the use of such cells.

This patent refers to sound reproducing apparatus utilizing a selenium cell, and its only reference to the photoelectric cell is in the last paragraph as follows—

> "The receiver, finally, may be any body endowed with photoelectric properties for example, a photoelectric cell using potassium or other metal having the same property. However, actually (or at the present time) the best receiver is the one which we know under the name of selenium cell". (R. 176.)*

The selenium cell is inoperative for sound reproduction. This patent teaches that the selenium cell is better than the photoelectric cell for sound reproduction. Therefore the disclosure and teachings of the patent suggest to one skilled in the art that a photoelectric cell should not be used, and would discourage one skilled in the art from attempting the use of a photoelectric cell in lieu of the selenium cell. This patent does not teach the invention at issue.

The specification of this patent refers, in erroneous and unscientific language, to several inoperative methods of recording and reproducing sound.

The specification indicates that the patentee could never have actually used the photoelectric cell for sound reproduction, and fails to disclose how he could have so used it.

26. The patent to Nicholson, No. 1,470,696 issued October 16, 1923 (applied for December 7, 1917) refers to television transmitting equipment embodying a photoelectric cell, and makes no reference to sound reproduction, and the arts of television and sound reproduction are nonanalogous.

27. Patent to Ries, No. 1,607,480 issued November 16, 1926 (applied for May 21, 1913) refers to a sound reproducing apparatus utilizing a selenium cell, but none of the difficulties of using a selenium cell for sound

*The parties disagree as to the proper translation, but the disagreement is not of importance, in my opinion.

reproduction are overcome in this patent, and the patentee fails to disclose an operative sound reproducing device.

28. Defendant's Exhibits U, V, W, X, Y and Z are descriptive of sound reproduction apparatus utilizing selenium as the light responsive element, no other alternative being specifically mentioned, and the selenium cell sound reproduction apparatus disclosed in these exhibits lacks practical utility and is subject to the same disadvantages of all proposed selenium cell sound apparatus as referred to in defendant's original exhibits.

29. Ernest Ruhmer, whose work is referred to in Defendant's Exhibits U, V, and W, was a man of high scientific attainments—conceded by many to be the leading investigator of his time in the art of light responsive electrical devices for sound reproduction. He experimented extensively in said art for a period of nearly ten years commencing prior to 1901 and terminating shortly after 1908. He devised various improved forms of selenium cells in connection with his work of sound reproduction. He expressed the "intention" of making use of sound reproduction with motion pictures, and expressed the "hope" to be able to perfect his sound reproduction to a point where it could be used publicly as in auditoriums, but the results were commercially impractical and not good enough to be exploited to his intended end; his work was never put to any practical, useful sound reproduction purpose, and was referred to by him as "experiments", and was discontinued or abandoned by him some years before his death shortly after 1912, although between said discontinuance and his death he conducted other scientific experiments. Publications of his work fail to show any realization on his part that the photoelectric

cell (then known) could be substituted for his selenium cell; the Duddell British patent of 1902, the Haines British patent of 1906 (Defts. Exs. X and Y) were published long prior to the termination of Ruhmer's experiments.

30. Although the British patent to Haines, No. 18,057 of 1906, refers to "certain substances" (specifically selenium) the resistance of which is variable under the influence of light, such statements have no reference to alkali cathode photoelectric cell phenomena. Haines states that he prefers the selenium cell. He could not have known that the photoelectric cell, as that expression is now understood, was perfectly adapted to the reproduction of sound. He does not disclose how a photoelectric cell could be used.

31. The British patent to Duddell, No. 24,546 of 1902 (Defts. Ex. Y) mentions that photoelectric apparatus other than the selenium cell may be used, but such statement does not disclose that what is known as the alkali cathode photoelectric cell or any cell using equivalent phenomena could be used, and this patent gives no suggestion of how a photoelectric cell could be used.

32. The megaphone horns and duplicate telephone referred to in defendant's exhibits U, V, W, X, Y and Z are not amplifiers within the meaning of plaintiffs' claims 3 and 4 here at issue.

33. Plaintiffs at the time they started their work on the invention here at issue were skilled and experienced scientists in the high frequency electrical art, but they were unable to put the photoelectric cell in circuits known to them and obtain sound reproduction, and after experimentation they found it necessary to devise their own electrical connections for utilizing the

photoelectric cell with amplifiers for sound reproduction; and had to devise special testing instrumentalities for study of the photoelectric cell, and do a great deal of experimental work before they were able to obtain suitable sound reproduction.

34. The utilization of the photoelectric cell for sound reproduction at the date of the invention here in issue, was not an obvious thing to one skilled in the art.

35. The patents and publications (Defendant's Exhibits A to J, inclusive, and Exhibits U to Z, inclusive) taken either singly or collectively, as of March 1919 and prior thereto, fail to teach or to suggest to one skilled in the art that the photoelectric cell was a suitable instrumentality for use in the reproduction of sound, or as a substitute for the selenium cell.

Said patents and said publications taken either singly or collectively fail to anticipate the plaintiffs' invention as defined in the claims here in issue.

FILED DEC 9 1931 FRANK E. CUNNINGHAM, CLERK

CONCLUSIONS OF LAW

1. Plaintiffs duly filed their United States patent application as described in Findings 1, 2, and 3; under the provisions of the Nolan Act such application is entitled to the effective date of March 3, 1919.

2. The claims here at issue are directed to a meritorious and novel invention which cannot be properly rejected on any of defendant's citations, or any combination thereof; the claims are patentable, and on the record before this Court a patent thereon should be granted.

DECEMBER 9 1931

JESSE C. ADKINS
Justice

FILED DEC 9 1931 FRANK E. CUNNINGHAM, CLERK

OPINION

Defendant refused to issue a patent to plaintiffs because the Patent Office tribunals found that plaintiffs' claims were for subject-matter disclosed in prior patents and publications. Many patents and publications are cited to support this conclusion. Defendants' principal contentions may be considered under two heads:

1. That prior to plaintiffs' invention a patent had been issued to Fritts for the reproduction of sound, which invention involved the use of the selenium cell; that other patents and publications known to the public referred to the selenium cell as an available instrument for translating light variations into electrical current for sound reproduction purposes; that the photoelectric cell accomplished the same purpose as the selenium cell, and that it was, within the meaning of the patent law, a mere equivalent for the selenium cell.

2. That the use of the photoelectric cell had been suggested in patents and publications as an alternative for the selenium cell in the sound reproducing art.

First: In my judgment the use of the photoelectric cell was not a mere equivalent of the selenium cell.

The photoelectric cell successfully performed (Findings 4, 10-12) a function which the selenium cell was unfitted to perform, and did not perform (Findings 6, 9).

Fritts' application for patent was filed in 1880, the patent being allowed in 1916.

Fritts was the first who claimed the use of the selenium cell in the reproduction of sound. His application was filed 14 years before the photoelectric cell was known. In various other patents and publications it is stated that the selenium cell was the best available instrument for sound reproduction purposes (See Finding 6).

In fact the selenium cell is seriously lacking in respect to the essential requirements of any light responsive cell in the successful reproduction of sound (See Findings 8, 9).

For these reasons the selenium cell was not successful in the accurate reproduction of sound.

Prior to plaintiffs' invention it was not known that the photoelectric cell had the essential requirements for reproduction of sound, and of course it was not known how to reproduce sound accurately by the use of the photoelectric cell (Findings 7, 10).

Plaintiffs by a long course of study and experimentation demonstrated that photoelectric cells in actual practice are able to meet all the requirements for sound reproduction (Findings 4, 7, 11), and they were the first to publicly exhibit talking motion picture films utilizing photoelectric reproduction of sound (Finding 4).

This was not the substitution of a known equivalent.

In *Duff Mfg. Co. v. Forgie,* 59 F. 772, 775, the Court of Appeals for the Third Circuit said:

> "An equivalent in the law of patents, is defined to be 'any act or substance which is known in the arts as a proper substitute for some other act or substance employed already as an element in an invention, whose substitution for that other act or substance does not in any manner vary the idea of means. It possesses three characteristics:

> (1) *It must be capable of performing the same office in the invention as the act or substance whose place it supplies:* (2) it must relate to the form of embodiment alone, and not affect in any degree the idea of means; (3) *it must have been known in the arts, at the date of the patent as endowed with this capability''.* (Italics supplied.)

See also *Judelson v. Hill Laundry Equipment Co.* 22 F (2nd) 262, 48 C. J. 80.

The cases cited by defendant on the subject of equivalents are in accord.

In *Leander Development Corp. v. Taft-Buick Corp.* 42 F (2nd) 823, 826, the court said:

> ''There is no invention in substituting one well known type of instrument for another''.

In *United States Hoffman Machinery Corp. v. Pantex Pressing Machine, Inc.* 35 F. (2nd) 523, the court said that in order to have patentability, in addition to novelty and utility—

> ''it must appear that that which the patentee has accomplished is something which the ordinary person, skilled in the art, would not know how to do if the occasion for it arose. . . . The substitution of a known equivalent does not amount to invention even if the substituted part performs the same function better''.

In *Northern Trailer Co. v. La Plant,* 21 F. (2nd) 686, the court said:

> ''It is not invention to produce a device which a skilled mechanic, upon suggestion of what was required, would produce''.

Plaintiffs were compelled to engage in a long course of study and experimentation before they ascertained that the the photoelectric cell was suitable to

their purposes, and further experimentation was required to determine how to use the photoelectric cell.

They did discover that the photoelectric cell performed a function which the selenium cell had failed to perform.

Their discovery was a great step forward in the accomplishment of the purposes desired. It made possible what had not been done theretofore. It meant the difference between failure and success. Within the meaning of the patent law it was invention, and was not the mere substitution of a known equivalent.

Second: In my judgment the patents and publications cited by defendant do not anticipate the use of the photoelectric cell in reproducing sound.

These references have been separately considered in the findings of fact.

Some relate to the use of the photoelectric cell in the reproduction of pictures (Polyphus, Finding 17; Nicholson, Finding 26). The problems arising in the two arts are quite different; obstacles are encountered in the reproduction of sound which do not arise in the reproduction of pictures. The arts are not analogous. These references do not show anticipation.

The French patent to Gabrie issued in 1913 in my opinion is the most important of defendant's references. The facts with respect to that patent are set forth in Finding 25. For the reasons stated therein I think it is not a bar to the claims of plaintiffs. In my judgment it is apparent from the patent itself that Gabrie did not know the properties of the photoelectric cell to reproduce sound accurately. He believed that the selenium cell was better adapted to this purpose than the photoelectric cell. In fact the selenium cell was and is a failure for this purpose, while the photoelectric cell is a success.

Gabrie also fails to disclose how to use the photoelectric cell in accomplishing his purpose.

The law on this subject is thus set forth by the Circuit Court of Appeals for the Ninth Circuit in *Carson v. American Smelting & Refining Co.* 4 F. (2nd) 463, at 465:

> "A foreign patent is to be measured as anticipatory, not by what might have been made out of it, but by what is clearly and definitely expressed in it. An American patent is not anticipated by a prior foreign patent, unless the latter exhibits the invention in such full, clear, and exact terms as to enable any person skilled in the art to practice it without the necessity of making experiments. Seymour v Osborne, 11 Wall. 516, 555, 20 L. Ed. 33; Hanifen v Armitage (C. C.) 117 F. 845; Permutit Co. v Harvey Laundry Co. (C. C. A.) 279 F. 713; General Electric Co. v. Hoskins Mfg. Co., 224 F. 464, 140 C. C. A. 150. In Westinghouse Airbrake Co. v Great Northern Ry. Co. 88 F. 258, 31 C. C. A. 525, the court said: 'The prophetical suggestions in English patents of what can be done, when no one has ever tested by actual and hard experience and under the stress of competition the truth of these suggestions, or the practical difficulties in the way of their accomplishment, or even whether the suggestions are feasible, do not carry conviction of the truth of these frequent and vague statements".

In *American Stainless Steel Co. v Ludlum Steel Co.* 290 F. 103, 106, the Circuit Court of Appeals for the Second Circuit, referring to the same subject, said:

> "It is necessary to show with reasonable certainty how the desired result can be accomplished".

The Gabrie patent did not exhibit the claimed invention in such terms as to enable any person skilled in the art as it then stood to practice the invention without the necessity of making experiments.

Duddell, in his British patent of 1902 (Finding 31) stated that in the place of the selenium cell he can use other photoelectric apparatus. I do not think he was referring to the photoelectric cell as herein meant (described in Finding 2), but that he meant a light sensitive cell of the resistance type; but the patent fails to disclose how to use the photoelectric cell in place of the selenium cell, and under the foregoing decisions is not an anticipation.

The same defect exists in the British patent to Haines of 1906.

Third: It follows that claims 1 and 2 of plaintiffs must be allowed.

From Findings 14 and 15 I think it also follows that claims 3 and 4 should be allowed.

Defendant has offered in evidence certain United States patents issued after March 3, 1919, plaintiffs' effective date. In my opinion these are not proper to show the prior state of the art as distinguished from anticipation, even though they were based on applications actually filed in the Patent Office prior to March 3, 1919. But in my judgment, assuming that they are admissible in evidence, they are not material.

I, therefore, overrule the objection to their receipt, as well as the motion to strike them out.

DECEMBER 9 1931

JESSE C. ADKINS
Justice

PLAINTIFFS' EXHIBIT NO. 11.

Certified Copy, Vogt, et al., Belgium Patent No. 292,-863, and Translation.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 12.

Copy of Vogt, et al., French Patent No. 532,651, Published February 9, 1922, With Translation.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 12-A.

Certified Copy Vogt, et al., German Application, Filed April 16, 1919, With Translation.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 13.

WARD, CROSBY & SMITH

(Letterhead)

September 8, 1925.

C. A. Norton, Esq.,
Legal Department
Radio Corporation of America,
233 Broadway, New York, N. Y.

Re Tri-Ergon, A.-G. U. S. Patent Cases

Dear Sir:

Referring to our recent conversation, I hand you herewith documents which I believe will be sufficient for you to get a preliminary knowledge of the Tri-Ergon U. S. cases.

I am sending you German and British patents which correspond more or less to various pending U. S. cases. We will, of course, show you the U. S. files themselves later, if our client instructs us to do so, which will doubtless be the case if the matter develops in a sufficiently satisfactory manner.

In the following list, I will note various patents and applications in the order in which they seem to come logically in the recording and then in the reproducing system for making talking moving pictures or sound recording and reproducing and will then list various miscellaneous cases, some of which cover alternative systems and others of which cover details of construction, tube arrangements and hook-ups, etc. and other miscellaneous matters including a method of making gramophone records. The electrical cases referred to in this part of the list are some of them used in our commercial talking moving picture system

and some of them are not used in the commercial talking moving picture system, but they might be of interest to you in connection with radio matters.

I hand you herewith:

1. Copy of our memo to Mr. Schroeder, August 19, 1925, sketching the situation.

2. U. S. issued patent 1,534,148 covering pick-up or microphone, which is termed the "Kathodophone". There are several additional applications covering details of construction, etc. which we probably can show you later.

3. Copy of German patent 387,059 with translation. This is somewhat similar to two U. S. applications, both allowed, on which patents will shortly issue showing the resistance coupling hook-up and high frequency transformer hook-up for the system.

4. German patents 368,367, 368,368 and 368,369 with translations corresponding to our pending application which is now in interference with DeForest patent 1,482,119, covering the glow light discharge recording system.

4a. German patent 369,075 with translation corresponding to pending U. S. case on detail of the glow light discharge tube, but not describing and illustrating same very completely.

5. German patents 387,058, 389,317, 389,318 and 389,319 with translations corresponding to pending U. S. case on mechanical features of the film feed, etc.

5a. German patent 368,383 with translation corresponding to U. S. application on making sound and picture negatives separately, developing separately

and then printing on the same film. We are trying to obtain an interference with a DeForest patent on this.

6. U. S. issued patent 1,512,681 covering process of making the positive films from the negative sound record films, to effect certain corrections.

7. U. S. issued patent 1,550,381, Aug. 18, 1925, on one form of the condenser telephone loud speaker. We have three pending applications covering other forms of this device, having different methods of avoiding resonance troubles by distributing the natural rates of vibration widely throughout the acoustic range, some of these being particularly adapted for radio loud speakers without horns. We can doubtless give you access to these later.

8. British patent 157,433 somewhat corresponding to a pending U. S. case on the use of the photo-electric cell, etc. Several prior art British patents are bound with this, and for convenience I leave bound with them our patent.

9. British patent 157,434 covering combination of photo-electric cell with condenser telephone loud speaker, etc. corresponding to a pending U. S. application.

Miscellaneous Features

10. German patent 369,074 with translation. This corresponds partially, with incomplete illustration, to a pending U. S. application on amplifier tube with multiple step amplification with a single cathode.

11. German patent 350,506 with translation corresponding to pending U. S. case on differential h.f. circuits controlled by photo-electric cell.

12. German patent 353,644 with translation corresponding to U. S. case on h.f. circuits. I note the

U. S. Examiner considers the last two cases as quite broadly new.

13. German patent 350,586 with translation, corresponding to pending U. S. case covering an amplifier tube with an anode screening electrode with a higher potential than the working anode.

14. German patent 350,999 with translation corresponding incompletely to pending U. S. case covering hook-up with positive bias on grids.

15. Copy of our allowed U. S. application on parallel connection of glow light discharge tube with amplifier. If this item is not included with the papers sent, it will be forwarded you shortly as soon as extra copy can be prepared.

16. German patents 350,705 and 350,706 with translations partly corresponding to pending U. S. case and describing sound recording system of the vibrating mirror type.

17. British patent 177,534 corresponding to pending U. S. case covering a phosphorescent screen method of sound recording.

18. German patent 391,188 with translation corresponding to U. S. pending application covering sound recording system in which cathode rays pass out from a cathode tube and act directly upon the moving film to make a photographic record corresponding to the sound.

19. German patent 350,709 with translation corresponding to a pending U. S. case covering the idea of having the kind of light, the kind of photo-cell and the kind of emulsion on the film all correspond in sound reproducing.

In addition, I refer to the following:

20. U. S. application A-29 covering method of making gramophone disc records involving the use of the ionized air gap pick-up and other features. I have no corresponding patent at hand and will try to send you the file of the U. S. application shortly if you wish it as the patent is about to issue.

21. Two pending applications A-19a and A-19b cover improvements in regard to the method of directing the light rays through a slit before they fall upon the film in both recording and reproducing, and also covering improvements in the light source for reproducing. In DeForest the film passes immediately behind the metal piece in which the slit is formed so that this slit picks up dust, etc. and causes imperfections in the recording and reproducing. This is entirely overcome by our method and I can give you details later.

22. U. S. Case A-41, I have no corresponding foreign patent at hand but can let you have this application later. It covers arrangements for overcoming the difficulty caused by the negative voltage curve of the glow discharge tube in combination with the amplifier and also covers various details and combinations in connection with the glow discharge tube recording device and the amplifying tubes, etc.

Quite a number of the pending applications referred to above have been allowed and various others are almost completely allowed. The pending U. S. cases describe, illustrate and claim the inventions much more fully in most cases than the corresponding foreign patents.

Yours very truly,

DS.AM

RADIO CORPORATION OF AMERICA

(Letterhead)

September 9, 1925.

Ward, Crosby & Smith,
233 Broadway, N. Y. C.

Attention: Dyer Smith, Esq.

Gentlemen:—

I am in receipt of your letter of September 8th, enclosing various patents and other information relating to Tri-Ergon U. S. cases.

As soon as opportunity offers, I will go into this matter to determine whether it is of interest to the Radio Corporation.

Yours very truly,

CLYDE A. NORTON

October 14, 1925.

Mr. C. A. Norton,
Legal Department,
Radio Corporation of America,
233 Broadway, New York, N. Y.

Re Tri-Ergon, A.-G. Inventions

Dear Sir:

In further reference to this matter, the German Tri-Ergon Company patents and translations of the same which we sent you with our letter of September 8th were taken from our Office files. I am going to replace these by ordering others but I find that in most cases I did not retain copies of the translations.

I understand that you expect these papers back from Schenectady shortly and I wish you would return all of these translations of German patents to me for a few days so that I can have copies made for our files

---

unless you have had extra copies made of these translations which you can let me have.

If these papers are likely to be at Schenectady for some time further, you might write them up there to have extra copies made of these translations of German patents and sent to us since I find that it is necessary to refer to some of them.

Yours very truly,

DS.AM

April 28,1926.

C. A. Norton, Esq.,
Legal Department,
Radio Corporation of America,
New York, N. Y.

Re Tri-Ergon, A.-G. Patent Cases in U. S.

Dear Sir:

Referring to our letter of September 8th last enclosing description of the various inventions owned by Tri-Ergon, will you please advise us whether the Radio Corporation has come to any decision in regard to being interested in these inventions or any of the same.

I imagine that your search in regard to this matter was completed some time ago.

Yours very truly,

DS.AM

RADIO CORPORATION OF AMERICA

(Letterhead)

April 30, 1926.

Messrs. Ward, Crosby & Smith
233 Broadway
New York

Gentlemen:

I have your letter of April 28 to Mr. C. A. Norton. We have completed consideration of the Tri Ergon patents, which you kindly submitted to us with your letter of September 8, 1925, and your letter of October 22, 1925. There has been a great amount of delay in this matter due to the large number of cases that you submitted and more especially to our lack of time to devote to the study of such a number of cases. It is not difficult to find time to consider one isolated patent, but much more than proportionate time is required to consider a large number of cases all having a common subject matter, as they cannot very well be considered separately at different times. I think you appreciate that this was the reason for the delay in writing you, but I would like to mention it.

In general it may be stated that we are not interested to any extent in the cases that were submitted, particularly since I gathered from my talks with Mr. Schroeder that a very large consideration was expected by the Tri-Ergon Company. There are a number of patent applications still in the United States Patent Office and we cannot, of course, foresee just what claims they will have when they finally issue. It might be that we would be interested in the patents when they are allowed, but at the present time we cannot form any conclusion in this respect. In view of this situation I am returning the patents referred to in your two letters without making an offer for rights. I cannot find the following in my files:

1. Copy of your memorandum to Mr. Schroeder of August 19, 1925.
2. Copy of British patent No. 154,434.
3. Copy of German patent No. 350,999.
4. Copy of your allowed United States application mentioned in item 15 of your letter of September 8. Inasmuch as you indicate that possibly this case has not been sent us, but will be sent later, I presume that it was sent us in form of an issued patent which is included in the patents that we returned.

I find no German patent 391,188 as listed in your item 18 in your letter of September 8, 1925, but there is a German patent 392,188, which I am returning and I think there is a typographical error in your letter.

Since the copies referred to are copies of issued patents, I am wondering if it is material whether these are returned to you or not. If it is I will write to our associated companies and see if they cannot be located. They probably have been mislaid somewhere in the files.

I am sorry that it was necessary to delay final consideration of these cases for such a great length of time, but I am gratified with the patience which you have shown in the matter.

Very truly yours,

IRA J. ADAMS

May 5, 1926.

Radio Corporation,
Legal Department,
233 Broadway,
New York, N. Y.

Attention of Ira J. Adams, Esq.

Dear Sirs:

We have received yours of the 30th ultimo returning Tri-Ergon files, and I am sorry to note that you are not in general interested in these cases at present.

A number of patents have issued on pending applications since you were given these data, and various other cases are allowed and the patents will issue in due course of time. I would be glad to have you advise us later if you are sufficiently interested in these to see them.

Yours very truly,

DS:AM

RADIO CORPORATION OF AMERICA

(Letterhead)

RECEIVED
Ent'd
MAY 11 1928
WARD, CROSBY & SMITH
Ref'd to .....

May 9, 1928.

Messrs. Ward, Crosby & Smith,
233 Broadway,
New York.

Gentlemen:

In 1926 we had some correspondence with your firm in respect to patents of the Triergon Company on sound motion pictures. At that time we were not in-

terested in sound movie matters further than development. Since that time we have organized RCA Photophone, Inc. and intend to actively enter the sound movie field. I am, therefore, going over our prior correspondence to again get into various matters that came to our attention during the past and am taking the matter up with you again for this reason. On looking over our brief digest of the Triergon patents I am not able to get a very clear idea as to what their cases consist of except I do note that one of them was in interference with DeForest.

I have heard that the Fox-Case Company has an option to acquire the Triergon patents, but that the option has not been exercised. If this option has not been exercised and has expired I would be very glad to go into the matter with you again. I presume that you are still the attorneys of the Triergon Company and, therefore, I am writing you, although the gentleman who originally took the question up with us was Mr. August Schroeder of 200 Fifth Avenue. Mr. Schroeder at that time did not seem to know much about the situation so I prefer to deal through you.

Very truly yours,
IRA J. ADAMS

October 22, 1929.

RCA Photophone Inc.,
411 Fifth Avenue,
New York, N. Y.

Gentlemen:

We are advised that you are using and marketing sound translating apparatus of a type which in our opinion constitutes infringement of U. S. Letters Patent No. 1,713,726, granted May 21, 1929, to H. Vogt

et al., which patent is owned and controlled by our clients, Mr. William Fox and American Tri-Ergon Corporation. On behalf of our clients we are therefore writing you to advise you of your infringement and demand that you at once cease the use and sale of such infringing apparatus.

Will you kindly advise us as promptly as possible of your intentions in the matter so that we may govern our actions accordingly.

Very truly yours,

FISH, RICHARDSON & NEAVE

(Letterhead)

RECEIVED
Ent'd
W Nov 19 1929
WARD, CROSBY & NEAL
Ref'd to SMW

NEW YORK,

November 18, 1929.

Messrs. Ward, Crosby and Neal,
233 Broadway,
New York City.

Vogt Patent No. 1,713,726.

Dear Sirs:

A few days ago, I telephoned to Mr. Ward about your notices to RCA Photophone, Inc. and Radio Keith Orpheum in which you allege infringement of patent No. 1,713,726.

As I told Mr. Ward, I will get the drawings of the apparatus which has been installed in quantities and which is now being installed, and send it to you so that you can consider it, and we may then talk it over. My

point of view is that that apparatus is not subject to the Vogt patent.

I have received only this morning your letter of October 22 to the RKO Productions, Inc. alleging infringement of this same patent.

We can consider all those three notices at the same time when I get the blue prints for you for which I have sent.

Very truly yours,

CHARLES NEAVE

FISH, RICHARDSON & NEAVE

(Letterhead)

NEW YORK,

November 29, 1929.

RECEIVED

Ent'd

MS Nov 30 1929

WARD, CROSBY & NEAL

Ref'd to SMW PH

Messrs. Ward, Crosby and Neal,
233 Broadway,
New York City.

Vogt Patent 1,713,726.

Dear Sirs:

Referring to our previous correspondence, I enclose a copy of the operating instructions for the R. C. A. Photophone.

This has been furnished to me, but I do not think that it shows the apparatus in sufficient detail, so I am asking that this be supplemented by more detailed drawings.

Very truly yours,

CHARLES NEAVE

N-S
Enclosure.

FISH, RICHARDSON & NEAVE

(Letterhead)
NEW YORK,
December 4, 1929.

RECEIVED
Ent'd
W DEC 5
WARD, CROSB & NEAL
Ref'd to PH

Messrs. Ward, Crosby & Neal,
233 Broadway,
New York City.

Vogt Patent 1,713,726.

Dear Sirs:

Referring to our previous correspondence, I enclose three blue prints of the sound adaptor in the form in which it is being put out.

If there is anything about this construction with reference to which you desire further information, please let me know and I will get it for you.

When you are ready, I should be glad to talk the situation over with you.

Very truly yours,

CHARLES NEAVE

N-S
Enclosures.

December 19, 1930.

Charles Neave, Esq.,
5 Nassau Street,
New York, N. Y.

Re—Vogt Patent No. 1,713,726 and RCA Photophone Inc. Infringement.

Dear Mr. Neave:

Several months ago you discussed the RCA photophone reproducing equipment over the phone with me, about which we had written charging infringement, and you stated in substance that they had a new construction and that you would send us drawings of this construction, but that you did not think it was worth while for us to consider the old construction in view of the changes that had been made. At the same time you expressed the opinion that the new construction did not infringe the patent (although you did not imply that the old one did), but I told you that in so far as we were informed of the new construction, I could not agree with you. You also said that you would send us drawings of the new construction, and some time thereafter we received a descriptive booklet of the reproducing apparatus and later blue prints of the same.

We have now had an opportunity to consider this matter and we find that the data that you sent us appears to be confined to the reproducing end of the system. It is our contention that some claims of the patent are not limited to this end of the system but are broad enough to cover the recording as well. Would you care to supply us with drawings or data of the pertinent parts of your client's recording equipment so that we may consider this before going further?

Your early attention to this matter will be greatly appreciated.

Very truly yours,

S. Mortimer Ward, Jr.

FISH, RICHARDSON & NEAVE

(Letterhead)

NEW YORK, January 7, 1931.

RECEIVED
Ent'd
Jan. 8/31
WARD, CROSBY & NEAL
Ref'd to .....

S. Mortimer Ward, Jr., Esq.,
225 Broadway,
New York City.

Vogt Patent No. 1,713,726

Dear Mr. Ward:

Referring to your letter of December 19th to Mr. Neave, who is now away for some days, I am advised that the R-4 recorder that the Radio Corporation, or one of its subsidiaries, has been marketing for about a year is described in the November, 1930 issue of the "Journal of the Society of Motion Picture Engineers", pages 653 to 670. Probably, this article will furnish you with the information you desire. If not, please let us hear from you.

Very truly yours,

STEPHEN H. PHILBIN.

January 14, 1931.

Mr. Stephen H. Philbin,
Fish, Richardson & Neave,
5 Nassau Street,
New York, N. Y.

Re—Vogt et al. Patent 1713,726.

Dear Mr. Philbin:

Replying to our letter to Mr. Neave on this subject of December 19th with respect to information about the R. C. A.'s recording apparatus, you kindly wrote us on the 7th inst. that you were advised that the "R-4 recorder" of your client or of one of its subsidiaries, which had been marketed for about a year, is described in the November, 1913, issue of the "Journal of the Society of Motion Picture Engineers", and that we should let you know if this article did not give the information desired. We have succeeded in getting a copy of this pamphlet and have studied your client's construction therein shown and described.

This is to advise you that we are of the opinion that your client's recording apparatus as shown and described in this pamphlet, as well as your client's reproducing apparatus as shown in the drawings that you previously submitted to us, and your client's previous apparatus for recording and for reproducing sound, each infringes the above patent.

We have been authorized by the owner of the patent, American Tri-Ergon Corporation, to advise you that if your client does not, with reasonable promptness, make arrangements for taking a license under this patent, we are to proceed to bring suit.

Will you kindly take this matter up with your client and advise us of its intentions in the matter. If the fact is that your client has already decided that it will not take a license, please so advise us at the earliest opportunity.

Very truly yours,

WARD, CROSBY & NEAL.

FISH, RICHARDSON & NEAVE

(Letterhead)

NEW YORK, January 15th, 1931.

RECEIVED
Ent'd
JAN 16 1931
WARD, CROSBY & NEAL
Ref'd to .....

Messrs. Ward, Crosby & Neal,
225 Broadway,
New York City.

RCA
Vogt, et al. Patent 1,713,726

Dear Sirs:

I am today communicating to our clients the subject matter of your letter of yesterday, and will advise you as soon as we hear from them.

Yours very truly,

STEPHEN H. PHILBIN.

FISH, RICHARDSON & NEAVE

(Letterhead)

NEW YORK, January 31, 1931.

RECEIVED
Ent'd
MS FEB 2 1931
WARD, CROSBY & NEAL
Ref'd to .....

S. Mortimer Ward, Jr., Esq.,
Ward, Crosby & Neal,
225 Broadway,
New York City.

Vogt Patent No. 1,713,726

Dear Mr. Ward:

I understand that the Radio Corporation or one of its subsidiaries is considering the manufacture or use of certain apparatus, in which some of the features purported to be covered by the Vogt patent No. 1,713,726 might be employed. A license under reasonable terms may be desired.

I suggest that if your client is interested, you or some other representative of it communicate directly with Mr. Otto S. Schairer, Vice President of the Radio Corporation, at 233 Broadway, concerning possible terms.

Yours very truly,

STEPHEN H. PHILBIN.

February 4, 1931.

Mr. Otto S. Schairer,
Vice-President, Radio Corporation,
233 Broadway,
New York, N. Y.

Re—Vogt Patent 1713,726.

Dear Sir:

I have received a letter from Mr. Stephen H. Philbin, to the effect that your company may desire to acquire a license under the above-entitled patent. I enclose herewith my reply to Mr. Philbin which is self-explanatory, and in connection with it I beg to say that we will get in direct touch with you after we hear from Mr. Fox.

Very truly yours,

S. Mortimer Ward, Jr.

W/V
Enc.

February 4, 1931.

Mr. Stephen H. Philbin,
Fish, Richardson & Neave,
5 Nassau Street,
New York, N. Y.

Re—Vogt Patent 1713,726.

Dear Mr. Philbin:

Answering yours of January 31st on this subject, I beg to advise you that I have communicated the substance of your letter to Mr. William Fox, of the American Tri-Ergon Co., the owner of the patent, and when I hear from Mr. Fox as to his wishes in the matter I will get in direct touch with Mr. Schairer, pursuant to your suggestion. At the present I do not know what Mr. Fox's intentions are with respect to the patents

held by this company, but I will probably be able to get in touch with him in the course of the next week or so.

Very truly yours,

S. MORTIMER WARD, JR.

(Letterhead of Radio Corporation of America)

February 26, 1931.

Mr. S. Mortimer, Ward, Jr.,
Ward, Crosby & Neal,
Transportation Bldg.,
New York, N. Y.

Dear Mr. Ward:

Referring to our discussion of a few days ago with regard to the Vogt et al patents, our people would be definitely interested in securing rights both for theater and home fields if such rights could be secured upon a reasonable basis. At your convenience, I should like to discuss the matter with you further.

Yours very truly,

(Signed) O. S. SCHAIRER (H)

October 30, 1925.

Mr. David Sarnoff, Vice President,
Radio Corporation of America,
233 Broadway, Woolworth Bldg.
New York City.

Dear Sir:—

Re:—Inventions of Dr. Engl, Massole & Vogt.

Through the courtesy of Mr. Davis you were kind enough to refer me to Mr. Adams, whom I interviewed on August 24th. Our attorneys, Messrs Ward, Crosby and Smith have furnished Mr. Norton with such material as was in their possession at the time, to which additional matter has been added as patents granted. I understand after passing on by your legal staff, this material has been forwarded to General Electric Co., Schenectady and will thence go to Westinghouse Electric Company, Pittsburgh, by reason of your arrangements regarding patents with these interests.

Since discussing these patents with Mr. Adams, I have refrained as promised to Mr. Adams discussing these patents with other parties who might be interested in any one or all of these patents, which as you know cover, Radio Broadcasting, Loud Speaker, Photo Electric Sound Recording and Reproducing, Acoustic Film and a new method of Gramophone disk recording.

Licenses have been granted in some foreign countries. For acoustic film in German Language to the Universum Film Company (Ufa) of Berlin, who are now engaged as I understand it in recording a number of acoustic films in the for this purpose reconstructed May film atelier in Berlin.

Complete apparatus and technically versed operatives are to visit this country for demonstration pur-

poses. I should like to time their arrival so, as to coincide if possible with completion of the general patent studies now progressing by your patent advisers. In the mean time would deem it a courtesy to hear from you, how far your interest goes in these inventions, so that I may not unnecessarily delay taking up discussions with others, in any of the fields covered by the various inventions.

I shall be very glad to take up with you and your associates the general terms and conditions as outlined by my principals when ever your search has reached a point for you to definitely render a decision, whether or not you desire to acquire any or all of the inventions in question. A number of pending patent applications could then also be submitted to your patent attorneys to complete their studies.

Anticipating the courtesy of an early response and assurance of highest esteem, I am

Yours very truly,

RADIO CORPORATION OF AMERICA

(Letterhead)

November 11, 1925.

Mr. F. A. Schroeder
200 Fifth Avenue
New York

Dear Sir:

Your letter of November 9 to Mr. Sarnoff has been referred to me for attention as Mr. Sarnoff is out of the city and probably will not return until next week.

You are correct in your understanding of the system that we are following in regard to the study of your patents. Such a large number of patents are

involved that it is a real task to even familiarize oneself with the specifications, without attempting to study the claims. So far we have done nothing further than to try to understand the inventions disclosed in the patents and have not made any searches to establish the validity of claims. In fact, it will take us probably a month or six weeks before we can finish consideration of the patent specifications, as it is difficult to find time to work on such matters continuously as you will appreciate.

I understand that you intend to have apparatus and technically versed operatives visit this country for demonstration purposes regardless of our possible interest in the inventions and if this is the case it is not necessary to wait until we have finished our report before you send the apparatus and the operatives here. It would seem that we should be in a position to witness demonstrations within the next two or three weeks, even though we have not had an opportunity to entirely finish the consideration of the patents and, therefore, there would be no real reason for your delaying the sending of the apparatus here. However, we have not studied the cases to sufficient extent to know whether we will be interested in acquiring these inventions or not and I, therefore, do not want to request that you send the apparatus here, but will leave it to your own judgment.

Very truly yours,

IRA J ADAMS

PLAINTIFFS' EXHIBIT NO. 14-A.

Certified Copy of Assignment From Vogt, et al., to Tri-Ergon, Ltd., Dated June 3, 1924, Referring to Application for Patent in Suit as Serial No. 545,377.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 14-B.

Photostat of Agreement and Assignment Between Tri-Ergon, A. G. and William Fox, Dated September 4, 1928, With Schedule of Patents and Applications, Including Application Serial No. 545,377 for Patent in Suit; and Attached Copy of License to Tri-Ergon Musik A. G., Including Schedule of Patents and Applications.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 14-C.

Translation of License to Tri-Ergon Musik A. G. Attached to Exhibit 14-B.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 14-D.

Photostat of Assignment from Tri-Ergon A. G. to William Fox, Dated February 15, 1929.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 14-E.

Photostat of Assignment From William Fox to American Tri-Ergon Corporation, Dated June 6, 1930, Referring to Patent in Suit by Number and by Serial Number of Application Therefor.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 14-F.

Photostat of Agreement Between Tri-Ergon Musik A. G. and Tri-Ergon Holding A. G., Dated November 10, 1931, and Attached to "A. E. G." License Re Foreign Rights, and Translation of Said License.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 14-G.

Photostat of Agreement Between Tri-Ergon A. G. and Tri-Ergon Holding A. G., Dated November 10, 1931.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 15.

Stipulation Between Counsel Covering Various Formal Matters and Certain Details and Diagrams of Defendants' Apparatus.

(Physical Exhibit.)

~~327~~

~~PLAINTIFFS' EXHIBIT NO. 15-A.~~

DIAGRAM OF
DEFENDANT'S **PS-1** SOUND APPARATUS

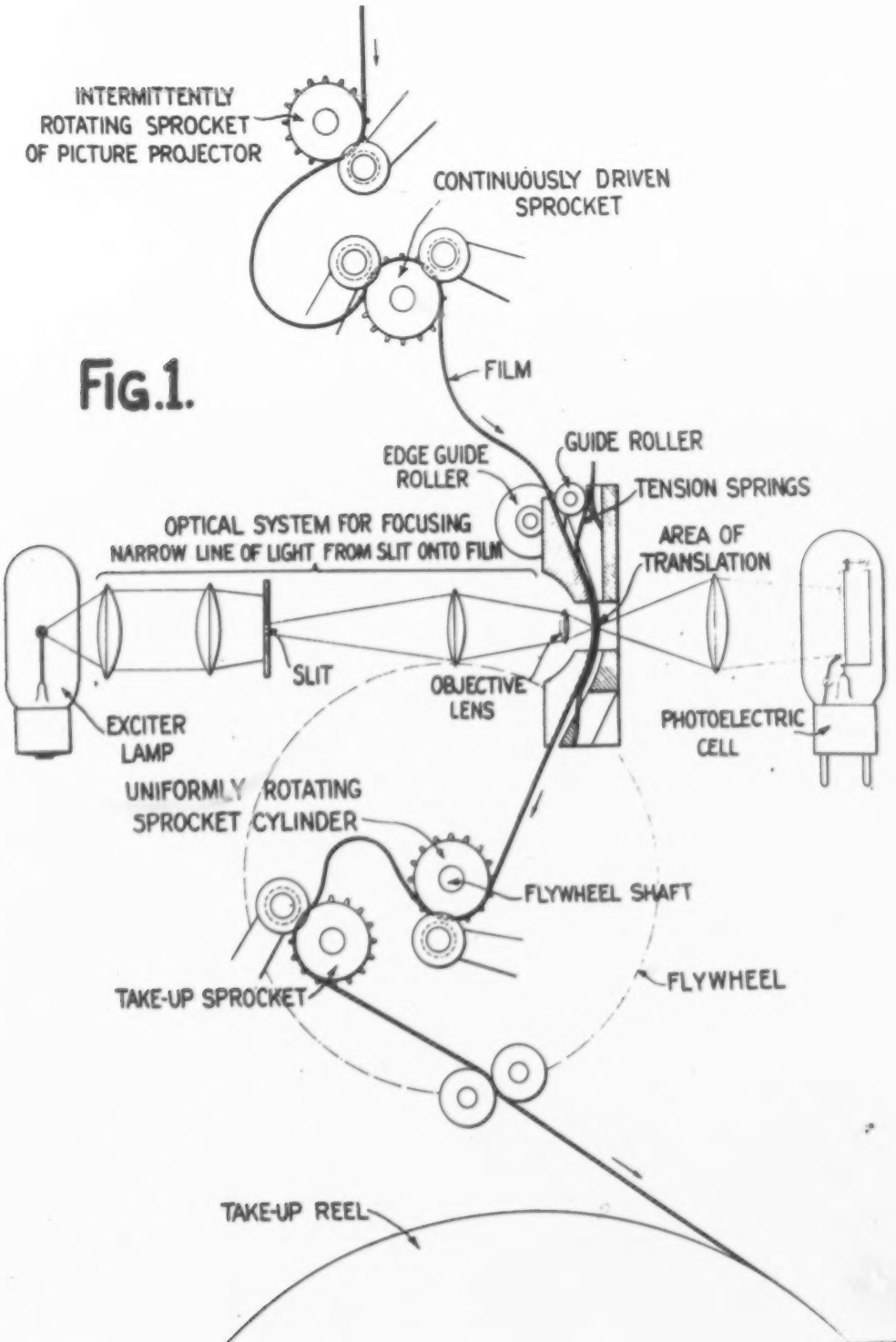


FIG.1.

PLAINTIFFS' EXHIBIT NO. 14-E.

Photostat of Assignment From William Fox to American Tri-Ergon Corporation, Dated June 6, 1930, Referring to Patent in Suit by Number and by Serial Number of Application Therefor.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 14-F.

Photostat of Agreement Between Tri-Ergon Musik A. G. and Tri-Ergon Holding A. G., Dated November 10, 1931, and Attached to "A. E. G." License Re Foreign Rights, and Translation of Said License.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 14-G.

Photostat of Agreement Between Tri-Ergon A. G. and Tri-Ergon Holding A. G., Dated November 10, 1931.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 15.

Stipulation Between Counsel Covering Various Formal Matters and Certain Details and Diagrams of Defendants' Apparatus.

(Physical Exhibit.)

DIAGRAM OF

DEFENDANT'S PS-1 SOUND APPARATUS

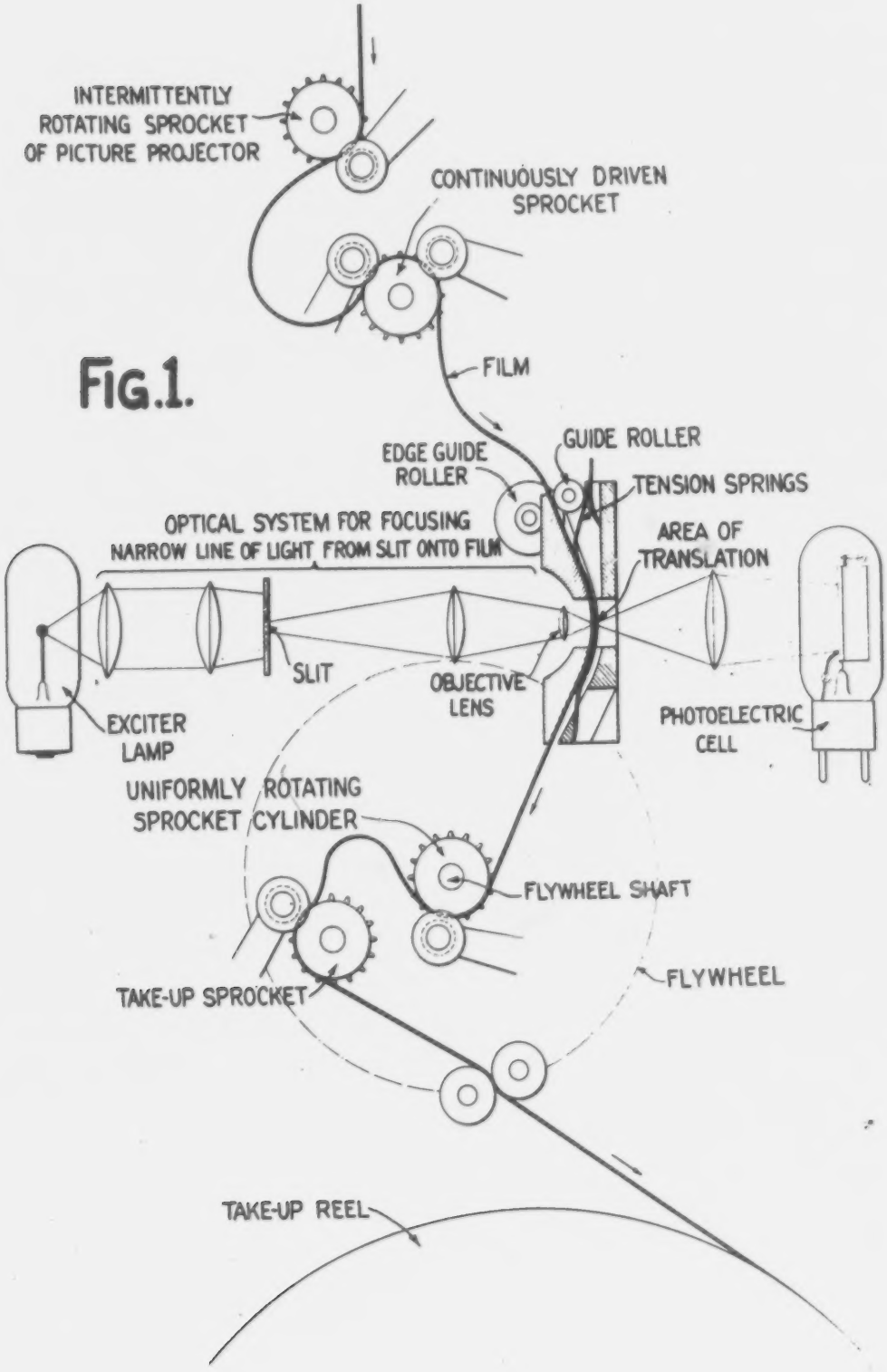


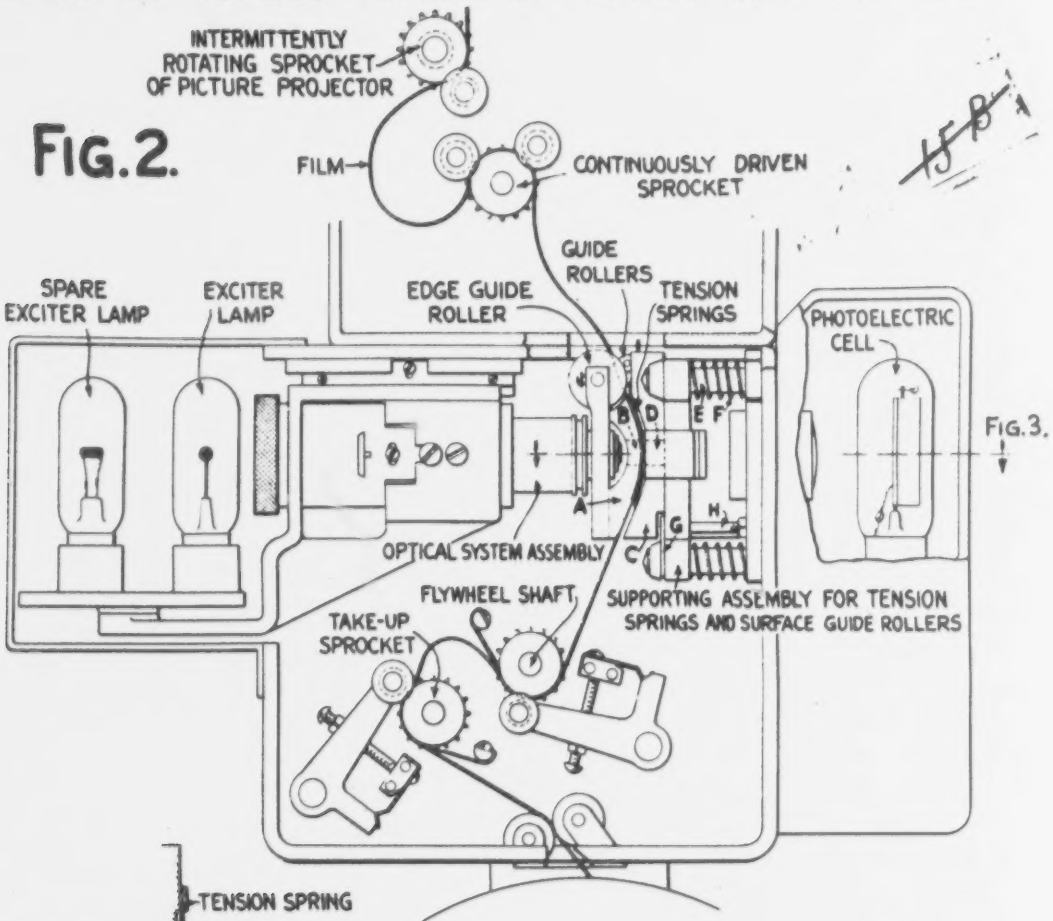
Fig.1.

~~28~~

~~PLAINTIFFS' EXHIBIT NO. 15-B.~~

DIAGRAM OF
DETAILS OF DEFENDANT'S PS-1 SOUND APPARATUS

FIG.2.



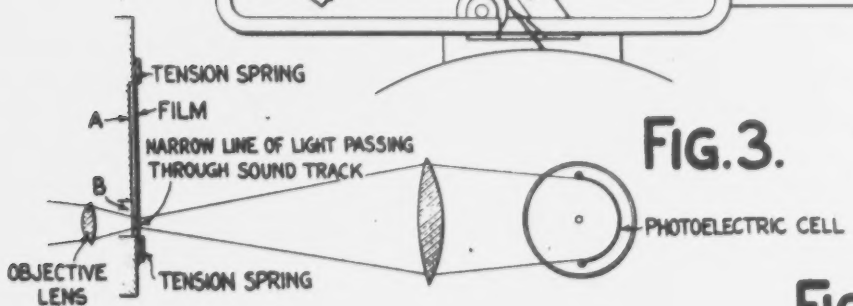


FIG.3.

FIG.4.

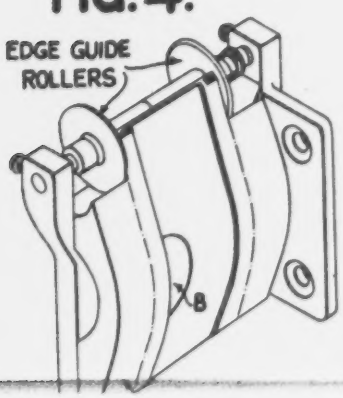
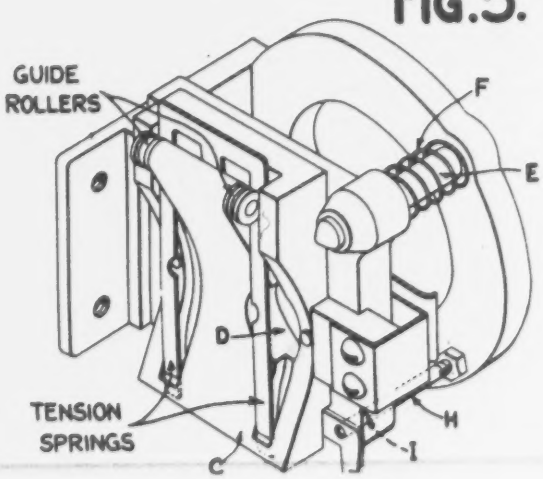


FIG.5.



~~PLAINTIFFS' EXHIBIT NO. 15-C.~~

DETAILS OF DEFENDANT'S PS-1 SOUND APPARATUS

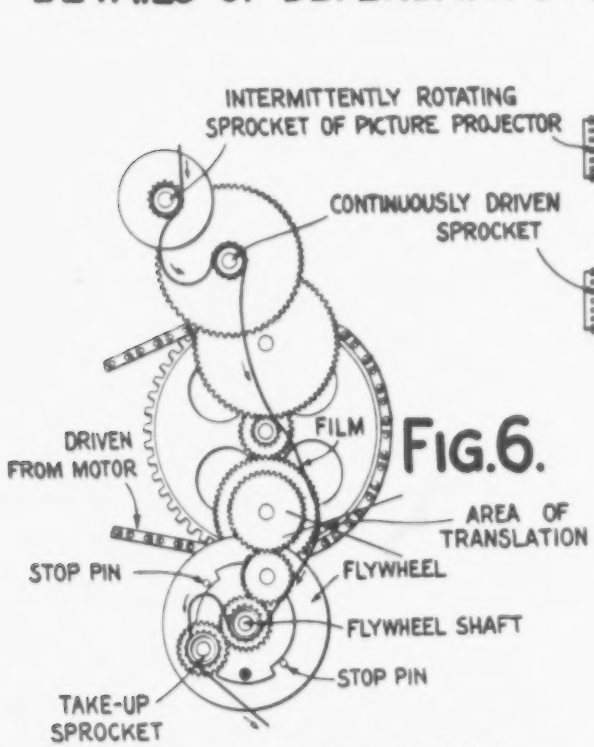


FIG.6.

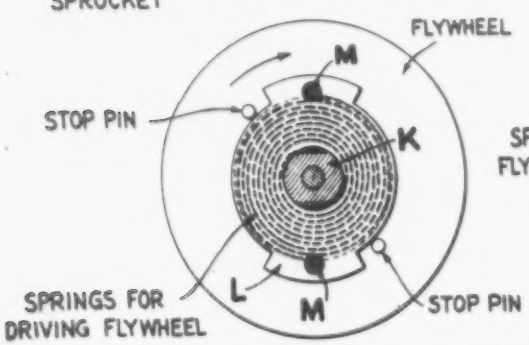


FIG.9.

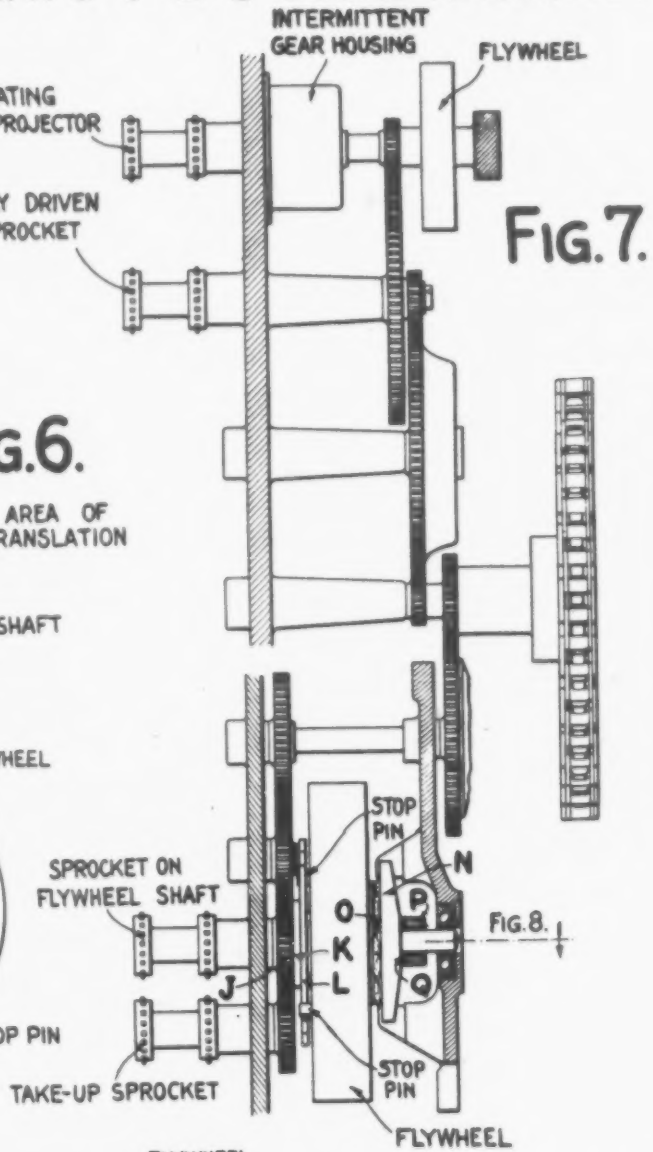


FIG.7.

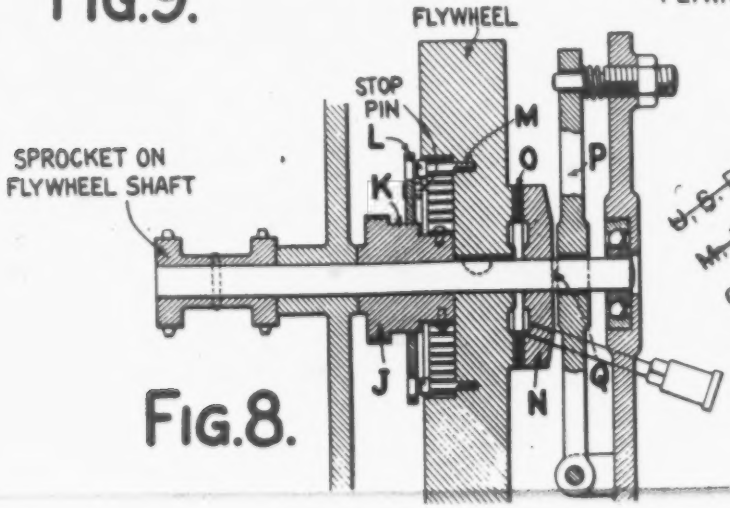
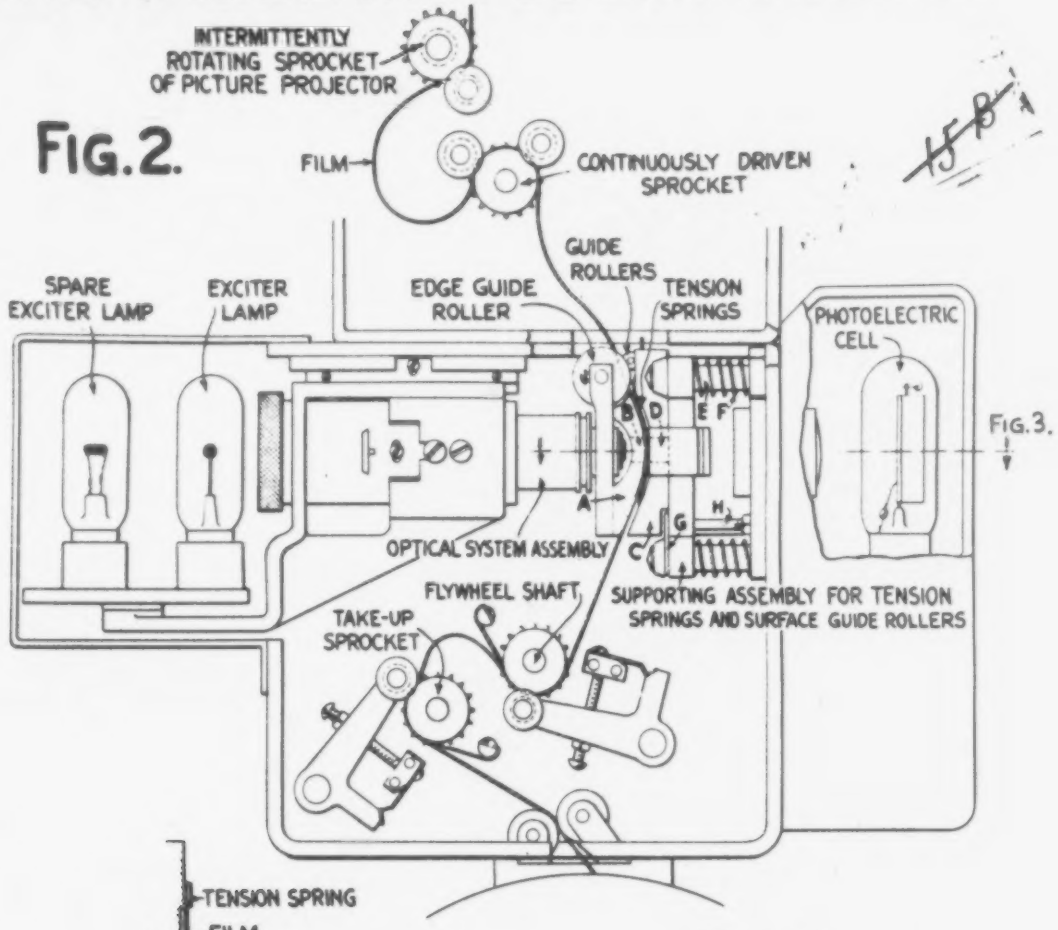


FIG.8.

U.S. DISTRICT COURT
M.D. PENN.
COMPL. EX. 15C

DIAGRAM OF
DETAILS OF DEFENDANT'S PS-1 SOUND APPARATUS

FIG. 2.



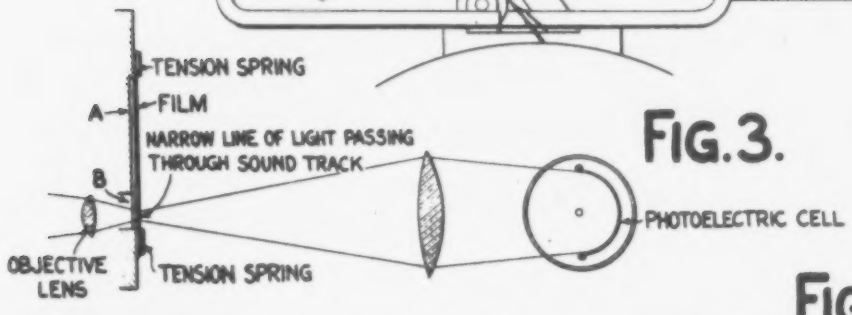


FIG. 3.

FIG. 4.

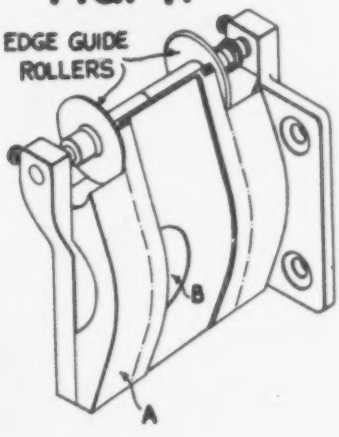
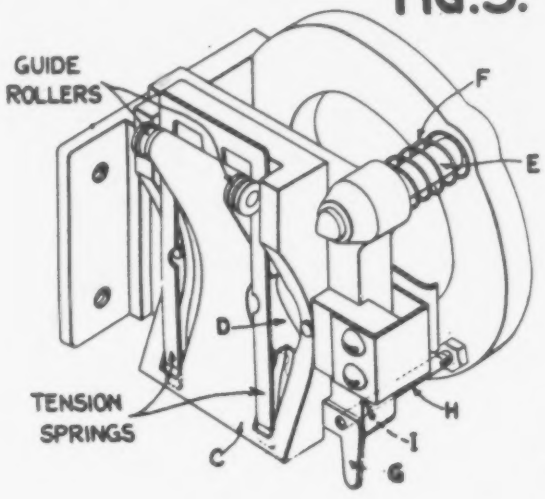


FIG. 5.



DETAILS OF DEFENDANT'S PS-1 SOUND APPARATUS

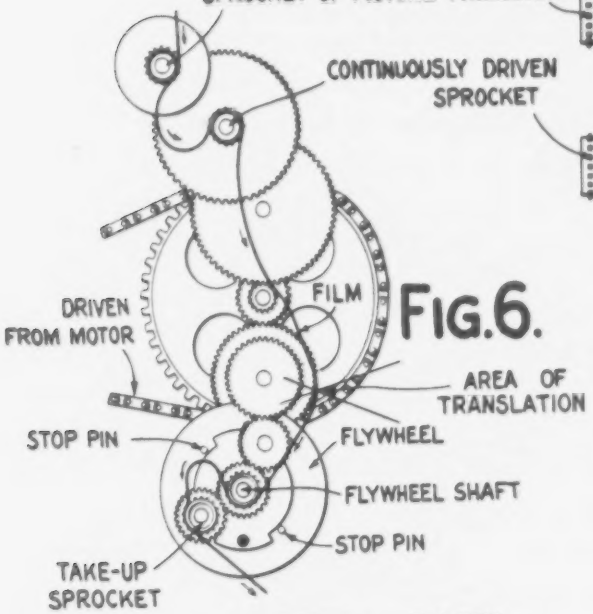


FIG.6.

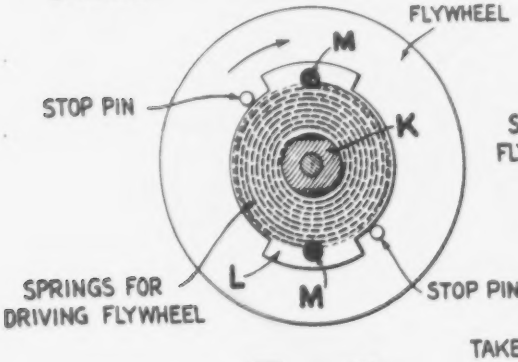


FIG.9.

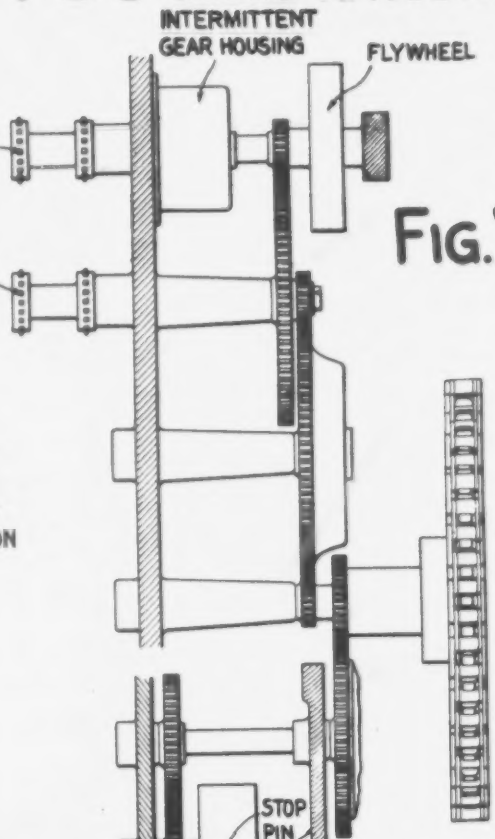


FIG.7.

FIG.8.

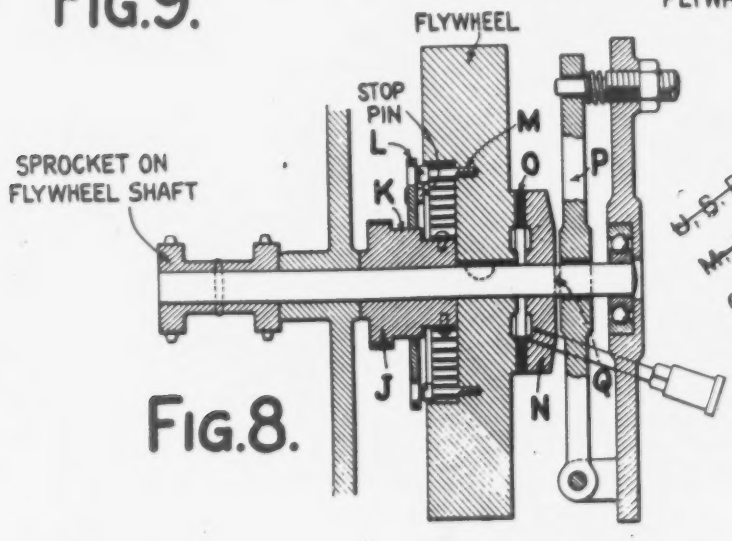


FIG.8.

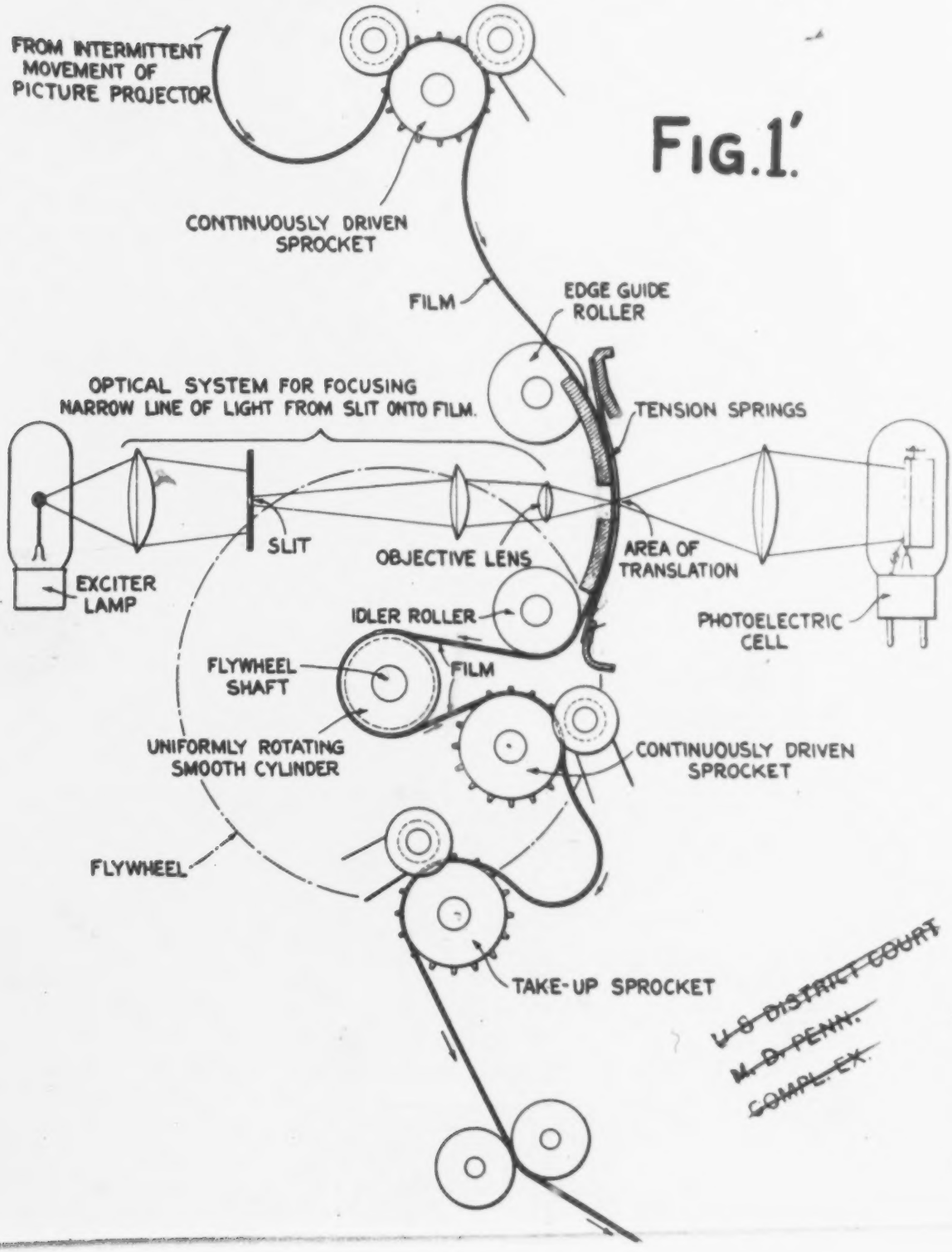
U.S. DISTRICT COURT
M.D. PENN.
COMPL. EX. 46

~~330~~

~~PLAINTIFFS' EXHIBIT NO. 15-D.~~

DIAGRAM OF
DEFENDANT'S PS-16 SOUND APPARATUS

FIG. 1.



~~U. S. DISTRICT COURT~~
~~M. D. PENN.~~
~~COMPL. EX.~~

~~PLAINTIFFS' EXHIBIT NO. 15 E.~~

~~331~~

DIAGRAM OF
DETAILS OF DEFENDANT'S PS-16 SOUND APPARATUS

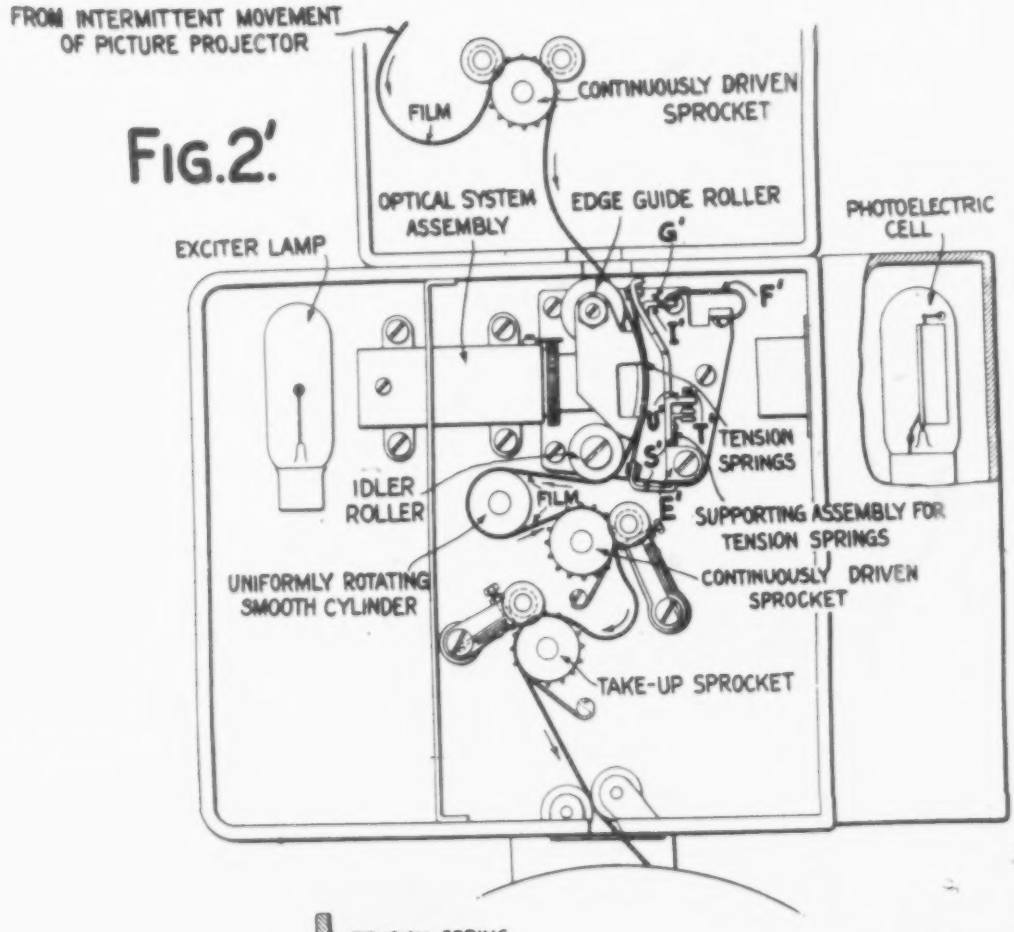


FIG.2'.

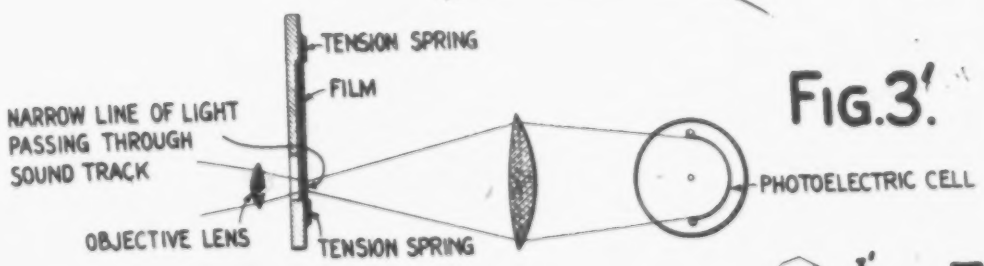


FIG.3'.

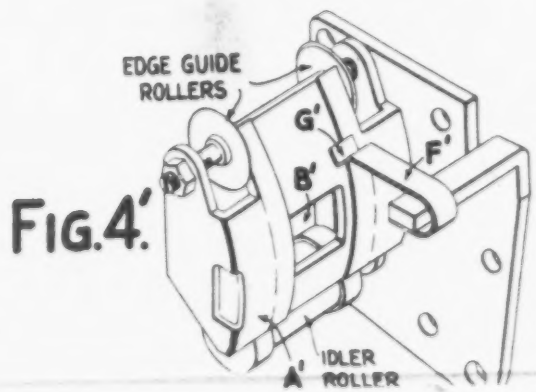


FIG.4'.

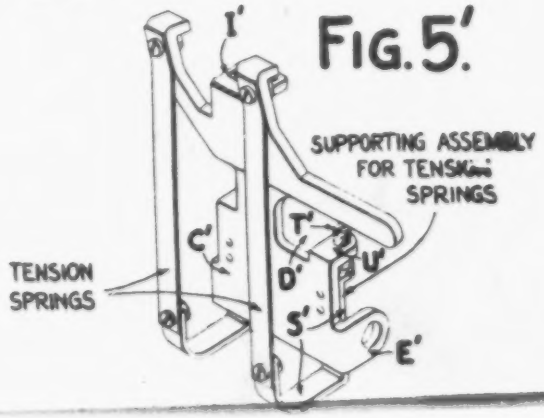


FIG.5'.

DIAGRAM OF
DEFENDANT'S PS-16 SOUND APPARATUS

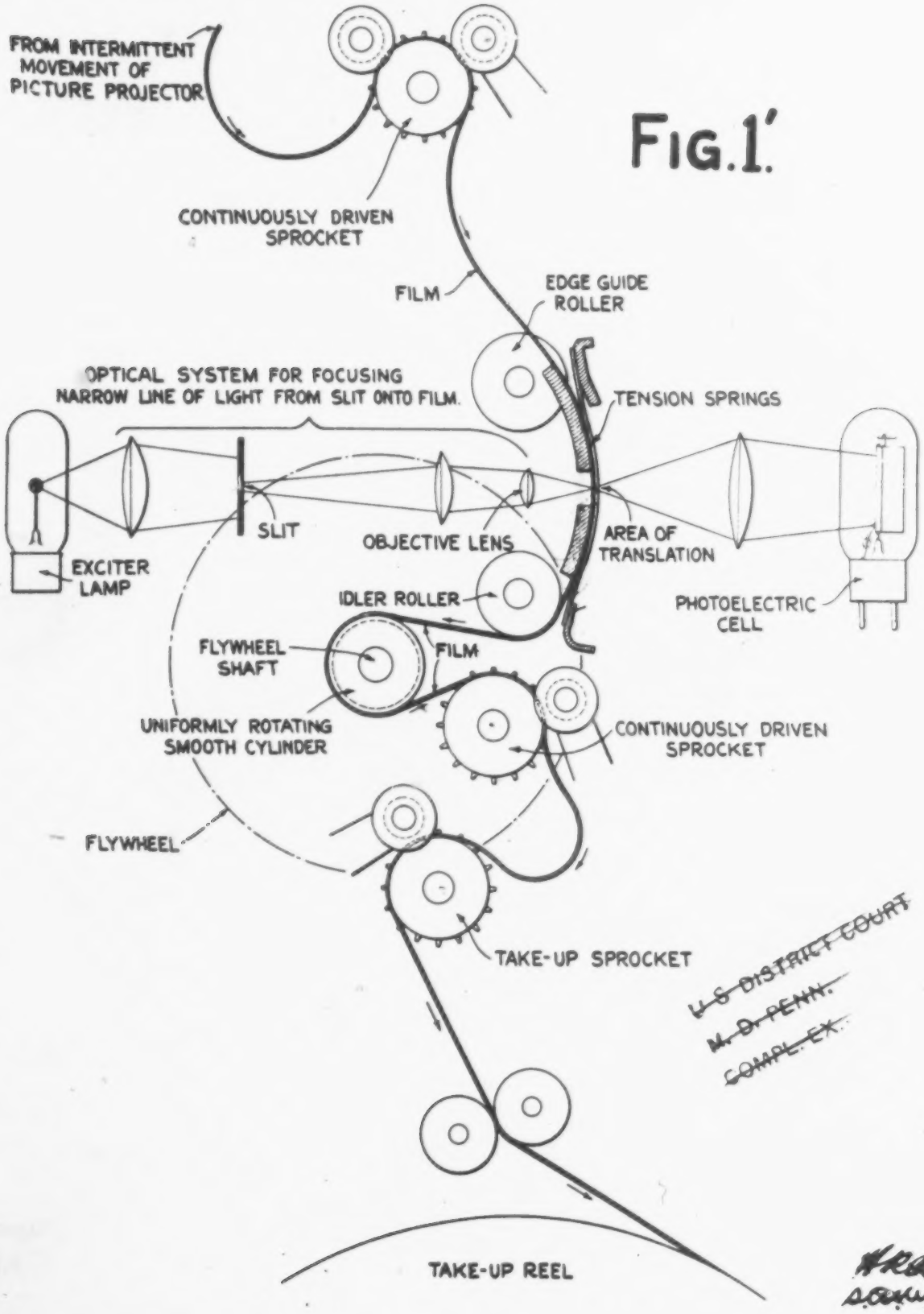


FIG. 1'

~~U.S. DISTRICT COURT~~
~~M. D. PENN.~~
~~COMPL. EX.~~

#12
sound

DIAGRAM OF

DETAILS OF DEFENDANT'S PS-16 SOUND APPARATUS

FIG. 2'.

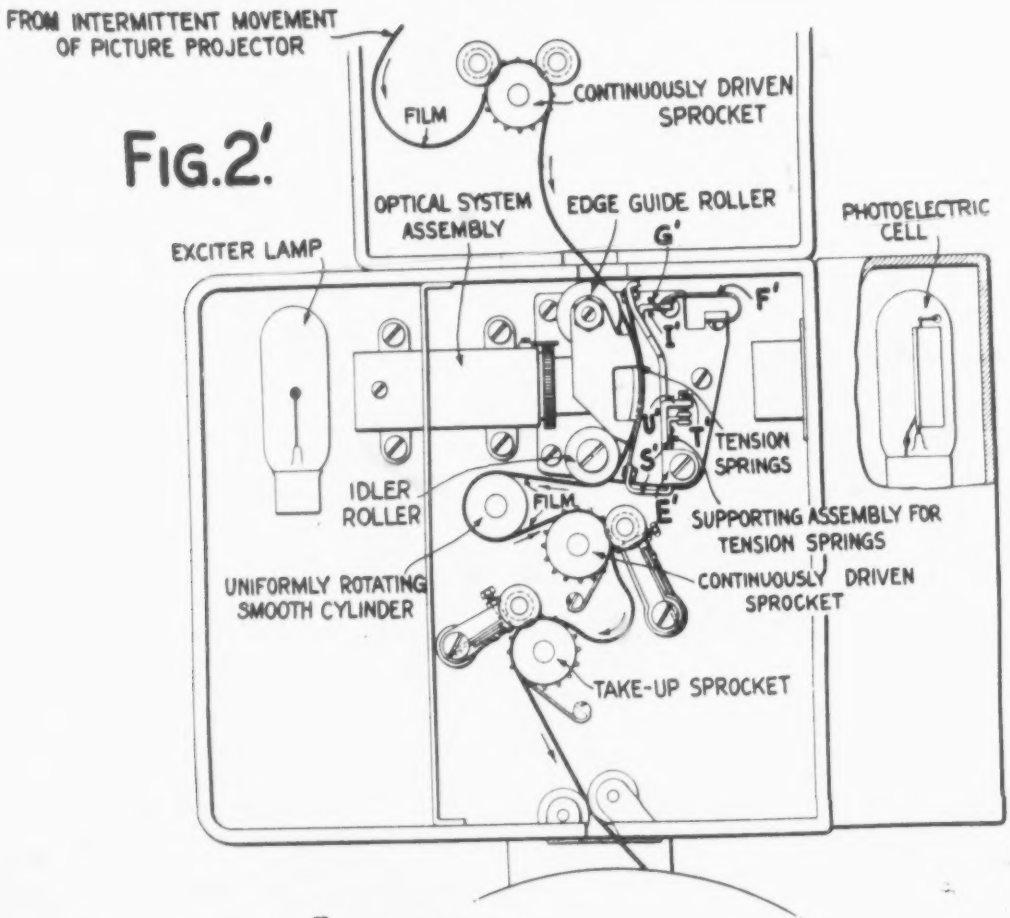


FIG. 3'.

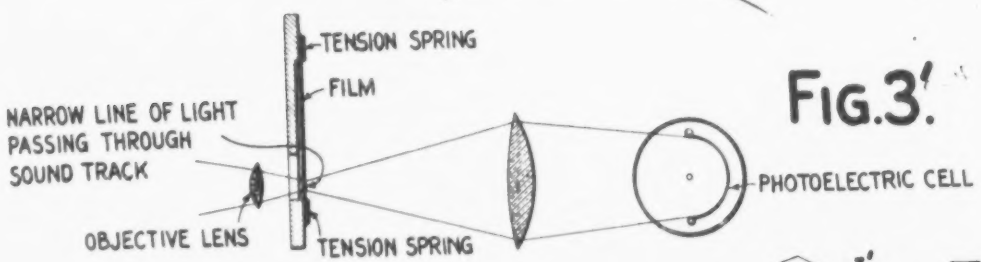


FIG. 4'.

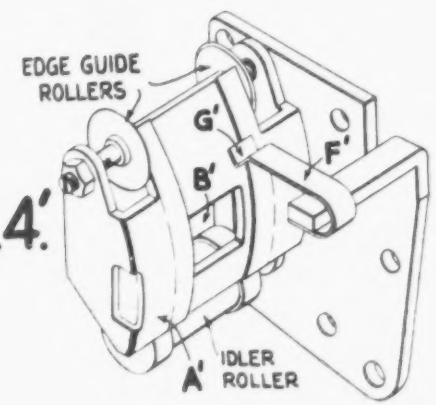
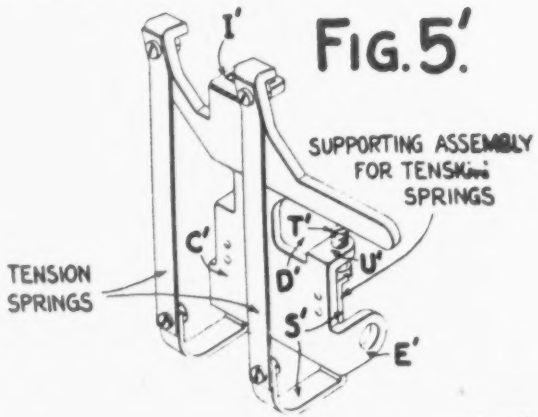


FIG. 5'.



~~PLAINTIFFS' EXHIBIT NO. 15 F~~

~~332~~

DIAGRAM OF
DETAILS OF DEFENDANT'S PS-16 SOUND APPARATUS

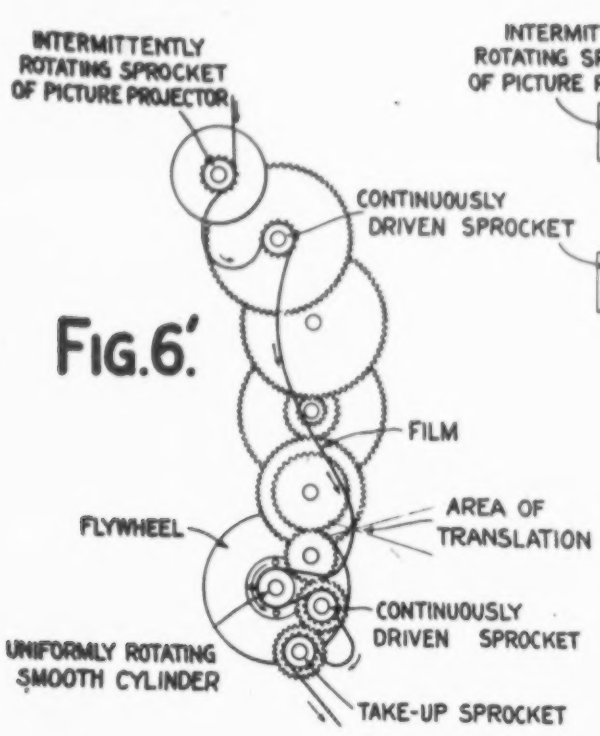


FIG. 6'

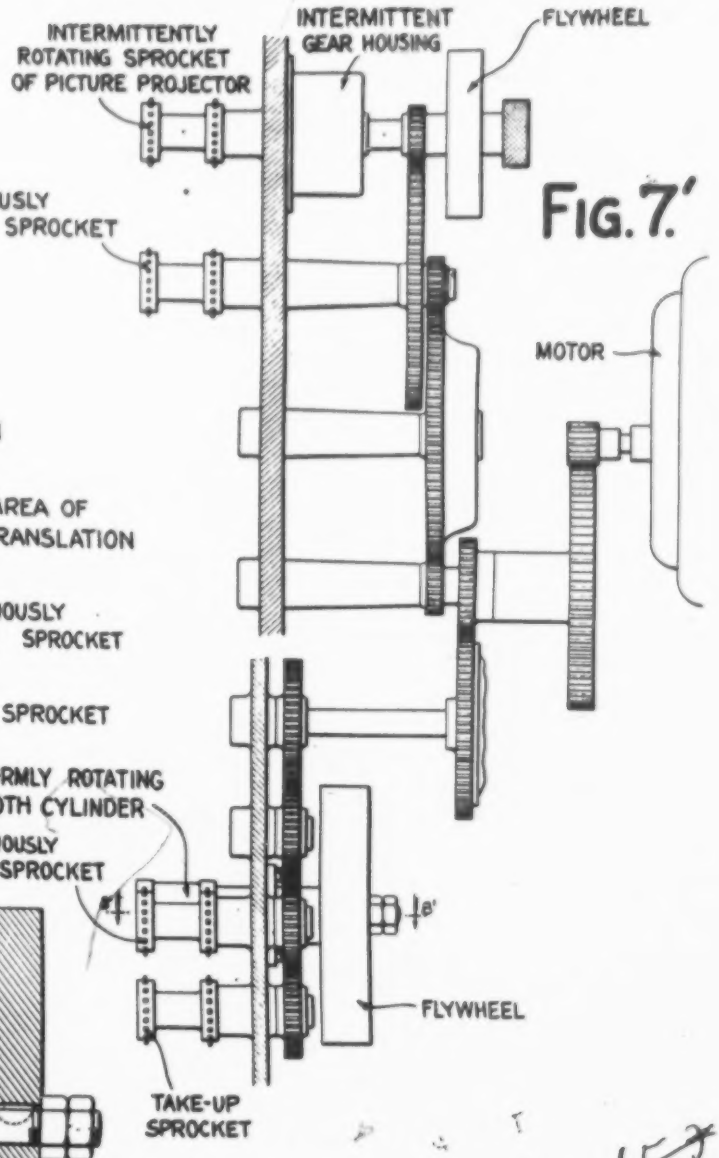


FIG. 7'

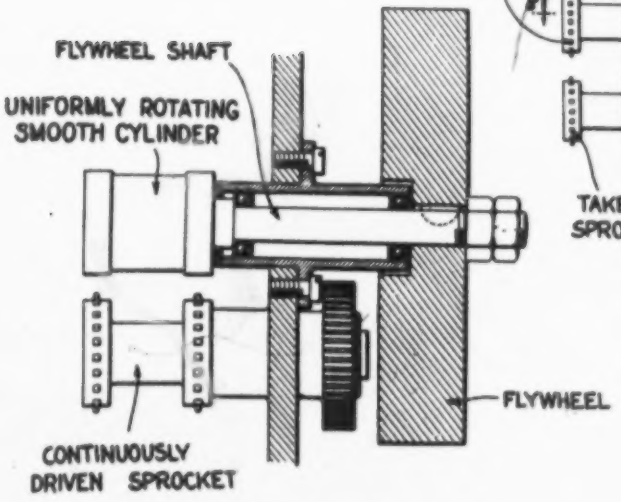


FIG. 8'

15 F

PLAINTIFFS' EXHIBITS NOS. 16-A TO 16-F INCLUSIVE.

Charts A to C of Defendants' Alleged Infringement PS-1 Apparatus; D to F, Charts of Defendants' Alleged Infringing PS-16 Apparatus.

(Physical Exhibits.)

(See reproductions Plaintiffs' Exhibits 15-A to F, supra.)

DIAGRAM OF
DETAILS OF DEFENDANT'S PS-16 SOUND APPARATUS

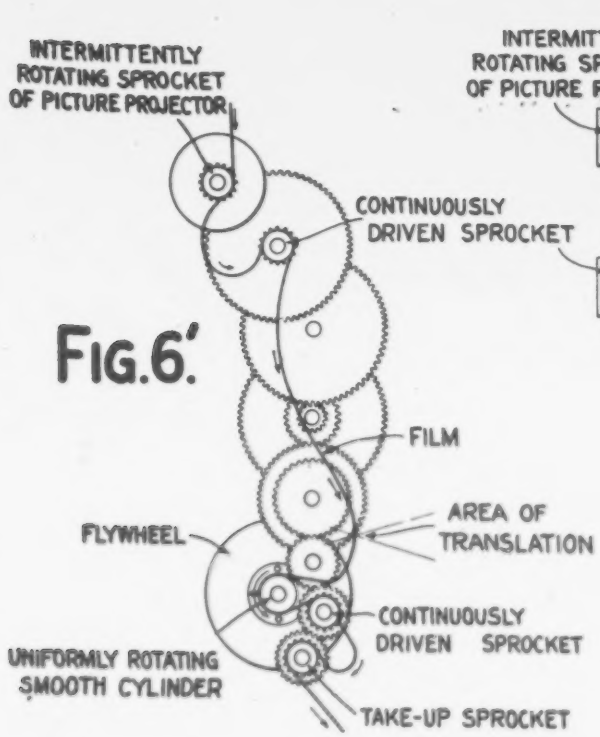


FIG. 6'

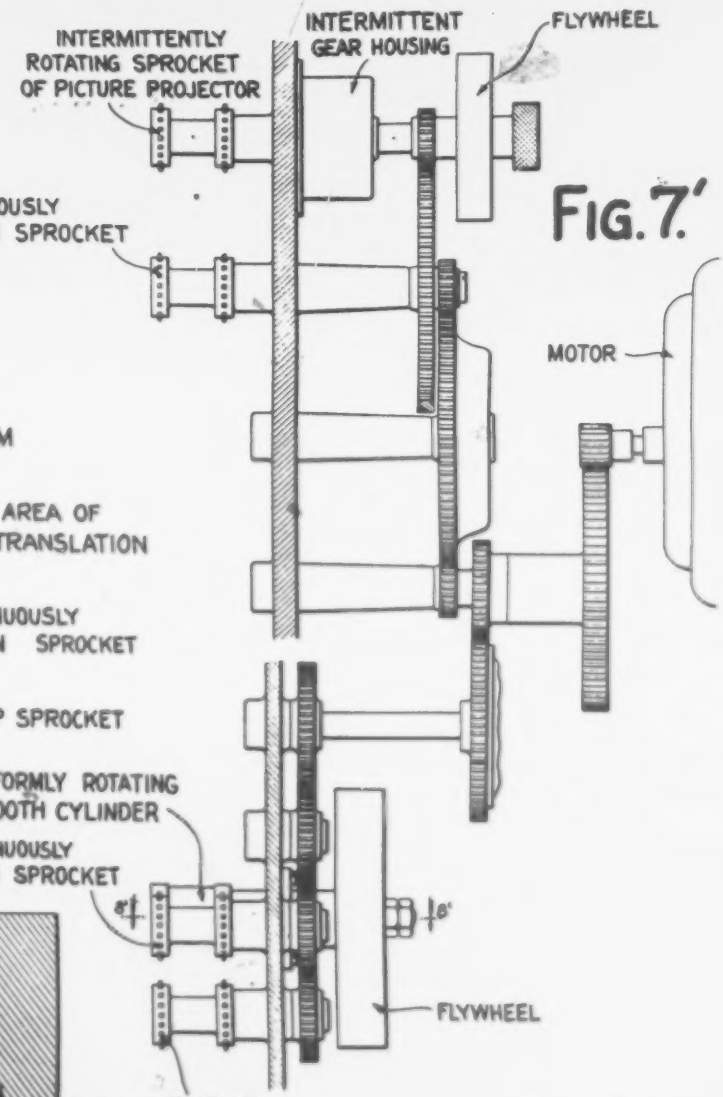


FIG. 7'

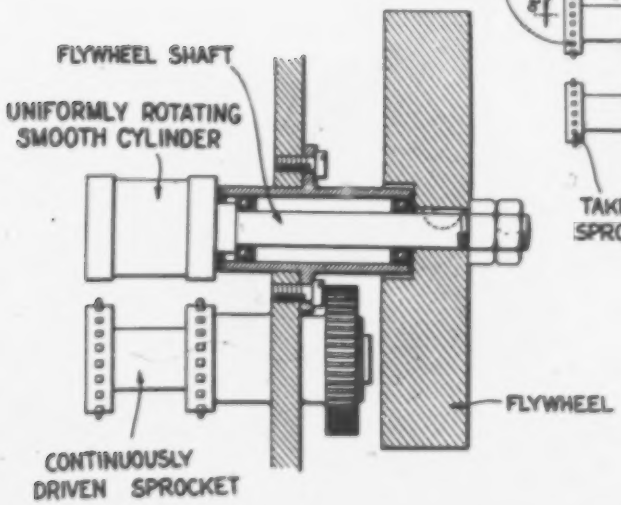


FIG. 8'

15

PLAINTIFFS' EXHIBITS NOS. 16-A TO 16-F INCLUSIVE.

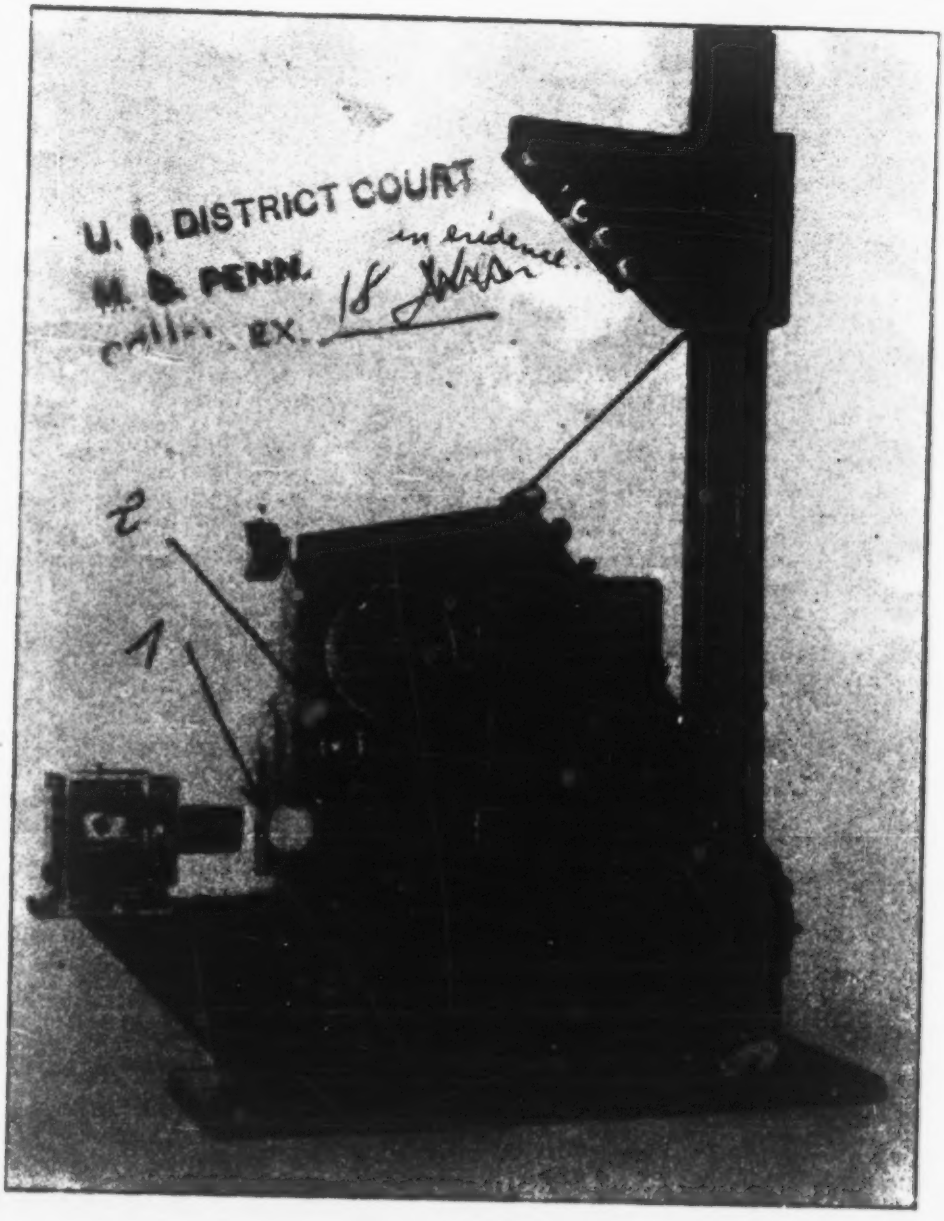
Charts A to C of Defendants' Alleged Infringement PS-1 Apparatus; D to F, Charts of Defendants' Alleged Infringing PS-16 Apparatus.

(Physical Exhibits.)

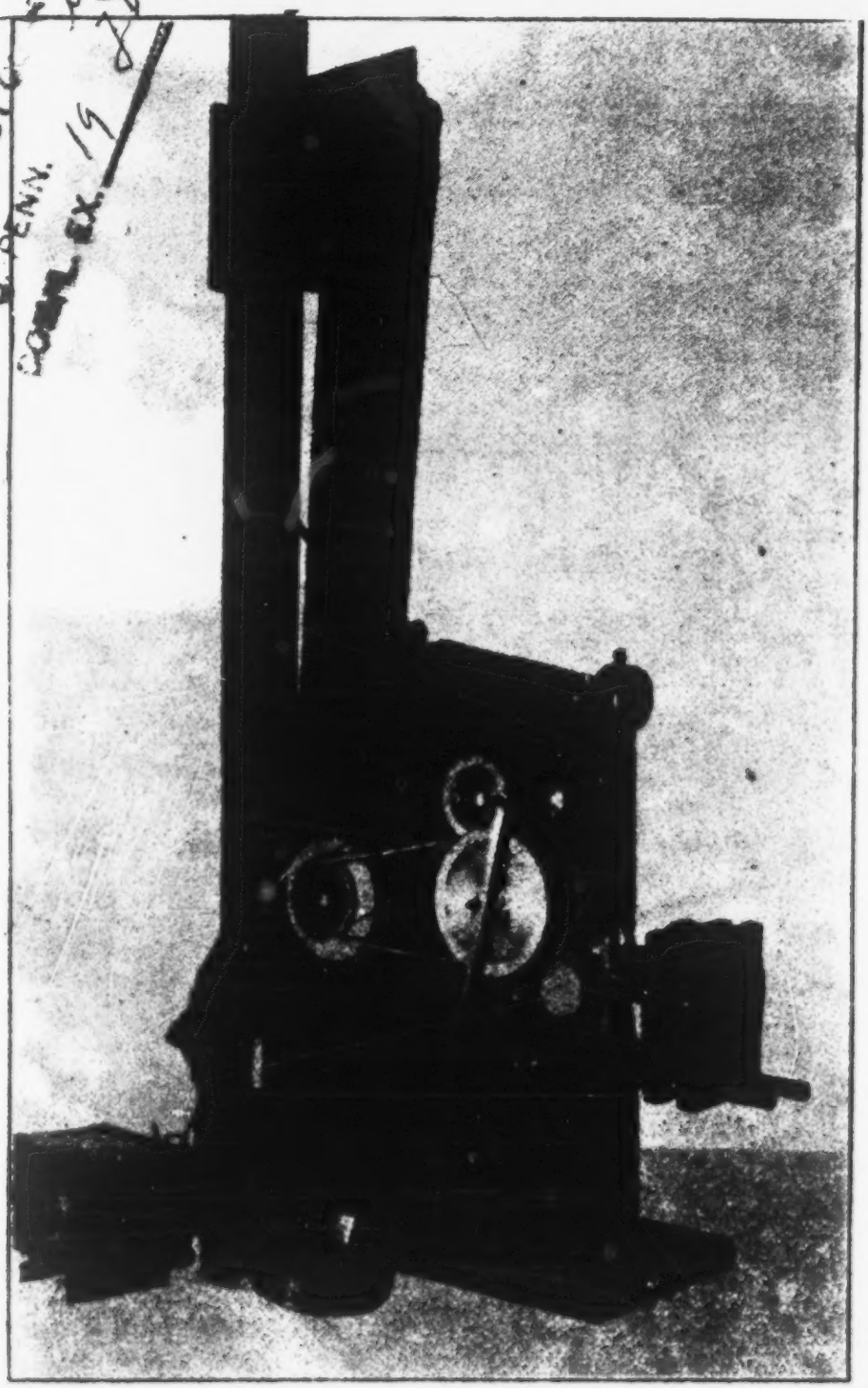
(See reproductions Plaintiffs' Exhibits 15-A to F, supra.)

PLAINTIFFS' EXHIBIT NO. 17.

PLAINTIFFS' EXHIBIT NO. 18.



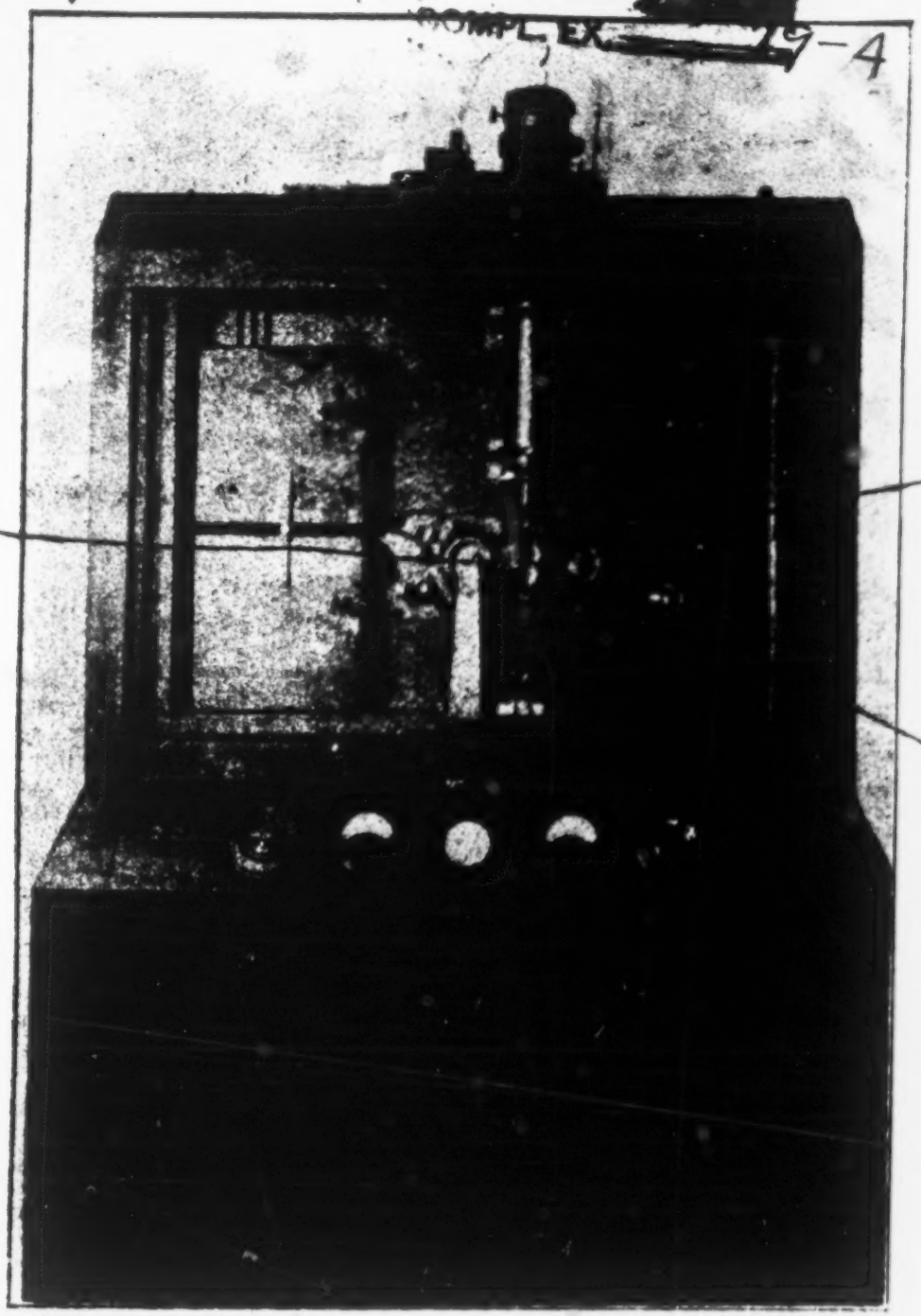
PLAINTIFFS' EXHIBIT NO. 19.



PLAINTIFFS' EXHIBIT NO. 19-A.

19

U. S. DISTRICT COURT
M. D. PENN.
COMPL. EX. 19-4



PLAINTIFFS' EXHIBIT NO. 20.

Strip of Specially Perforated Sound and Picture Film, 1923.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 21.

Short Strip of Standard Film.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 22.

Sample Invitation Card for Vogt et al. Alhambra Theatre Demonstration, Berlin, September 17, 1922, (Translation in Pencil on Reverse Side).

Berlin-Wilmersdorf, den 9. September 1922
Babelsberger Straße 49

Einladung

Auf Veranlassung von Herrn .....

gestatten wir uns, Sie zu der am **Sonntag, den 17. September 1922, vormittags 11½ Uhr**, pünktlich in der **„Alhambra"**, Kurfürstendamm 69, stattfindenden

Erstaufführung akustischer Filme

unter Beifügung der Einlaßkarte ergebenst einzuladen.

U. S. Laboratorium für Kinematographie

Es wird höflichst gebeten, Karten, für die keine Verwendung besteht, umgehend zurückzusenden

U.S. DISTRICT COURT
EASTERN DIST. PENN.
COMPL. EX. 22

PLAINTIFFS' EXHIBIT NO. 22.

Sample invitation card for Vogt et al. Alhambra Theatre demonstration, Berlin, September 17, 1922,

---

(translation in pencil on reverse side).

Invitation

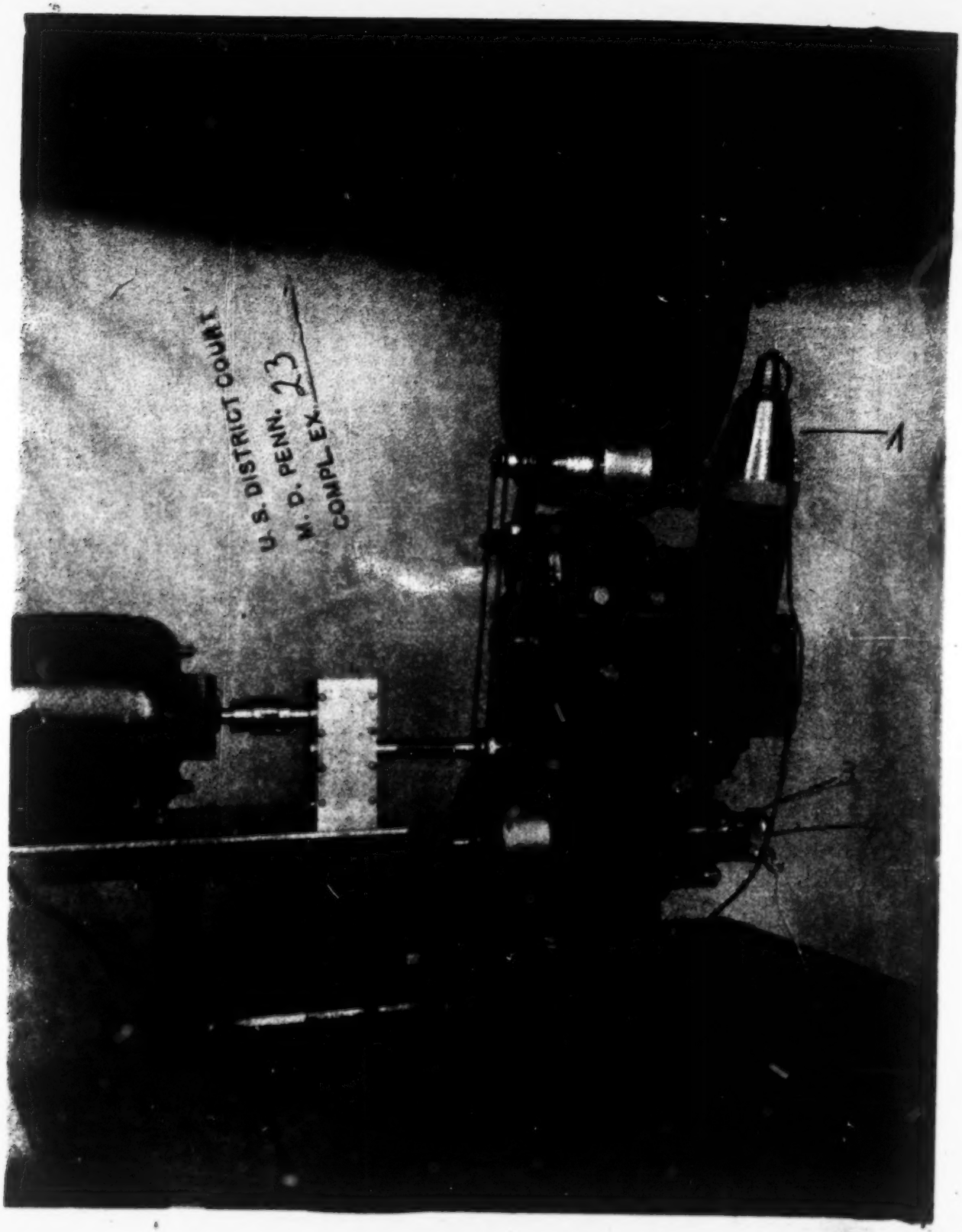
Through courtesy of Mr. ..... we have pleasure to invite you to a première of

Acoustic Films

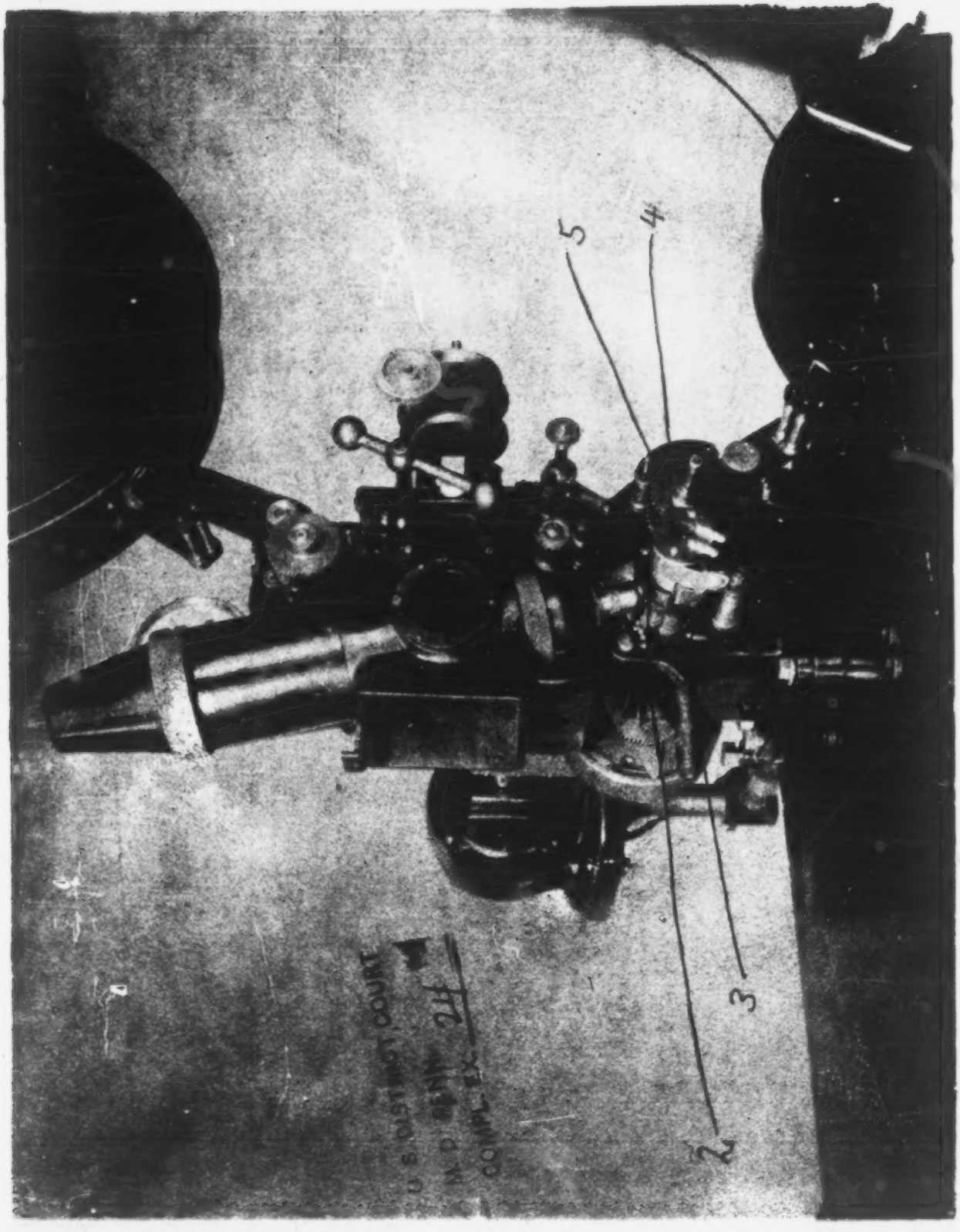
Sunday Sept. 17th 1922, 11.30 A. M. in Alhambra-Theatre, Kurfürstendamm 69.

Laboratory for cinematography.

PLAINTIFFS' EXHIBIT NO. 23.



PLAINTIFFS' EXHIBIT NO. 24.



PLAINTIFFS' EXHIBIT NO. 25.

Slip from Patentee's Notebook Showing Photographed Image of Typical Narrow Slits Tested, April, 1921.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 26.

United States Patent No. 1,587,786.

June 8, 1926. 1,587,786

J. MASSOLLE ET AL

ELECTRON TUBE

Filed April 4, 1921

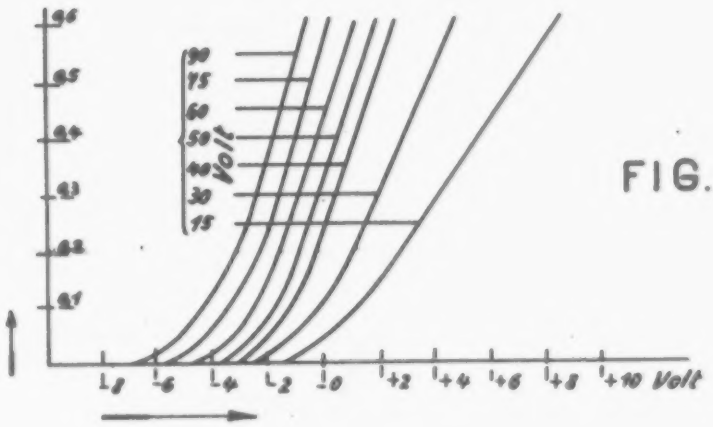


FIG. 1.

FIG. 2.

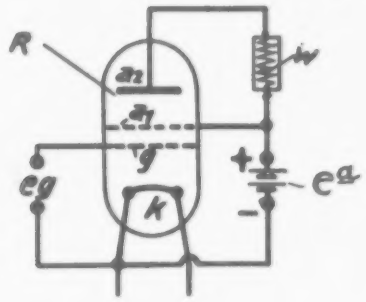
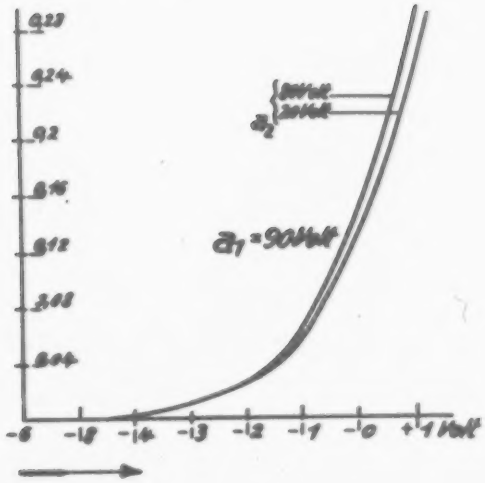


FIG. 3



INVENTORS:
JOSEPH MASSOLLE
HANS VOGT
JOSEF ENGL
BY Munn & Co.

Patented June 8, 1926. 1,587,786

UNITED STATES PATENT OFFICE.

JOSEPH MASSOLLE, OF GRUNEWALD, HANS VOGT, OF BERLIN-SCHONEBERG, AND JOSEF ENGL, OF GRUNEWALD, GERMANY, ASSIGNORS TO TRI-ERGON LIMITED, OF ZURICH, SWITZERLAND.

ELECTRON TUBE.

Application filed April 4, 1921, Serial No. 458,635, and in Germany December 2, 1919.

The invention relates to electron tubes, particularly to thermionic amplifying tubes. The invention aims to improve the effectiveness in operation of amplifier tubes, by overcoming an effect, or action, in the operation of amplifiers of common type, which tends to reduce the amplifications secured thereby. In the operation of the well-known amplifier having an effective resistance in series with the plate-filament path of the tube, across the constant source of potential (B battery), of the tube, variation of input voltage causes a variation in the plate-filament potential difference. With grid potential increasing from negative to less negative the plate current will increase and the potential difference between plate and filament decreases. The operating conditions of the tube now correspond to a different current-voltage curve; and a comparison of curves plotted for different potentials at the plate will demonstrate that the amplification indicated by the second curve may be less than that indicated by the first curve.

The effectiveness of the tube will, of course be improved if a characteristic curve of desirable steepness be selected, and if such arrangements be provided that the operation will remain substantially on the same curve, regardless of varying potential differences between plate and filament. The present invention provides means for accomplishing this object, or, generally speaking, for reducing the effect of variations in the plate potential in varying the amplification factor of the tube. This is accomplished by the provision of an auxiliary anode, or anode screening member, preferably positioned between the plate or working anode and the grid, and connected to the constant potential source of the tube, preferably in such manner that the potential difference between this screening member and the filament is less than that between the plate or working anode of the tube, and the filament.

In order that the invention may be more clearly understood, attention is hereby called to the accompanying drawings, in which:—

Figure 1 is a diagram giving a series of characteristic curves for a usual type of amplifier tubes, the horizontal co-ordinate indicating grid voltages and the vertical co-ordinate indicating plate current in milli-amperes, while the numerals at the left hand side of the curves indicate the plate potentials of the various curves, in volts;

Fig. 2 is a view of an electron discharge tube having an anode screening member, or auxiliary anode, in accordance with the present invention; and

Fig. 3 is a diagram of current voltage curves for the construction shown in Fig. 2, the horizontal co-ordinate indicating grid voltages, and the vertical co-ordinate indicating plate current in milli-amperes.

The curves shown in Figure 1 represent by way of example the relations between grid potentials and plate current for varying plate potentials, recorded with ordinary amplifier tubes, the right hand curve corresponding to 15 volts plate potential and the curves to the left thereof successively 30, 40, 50, 60, 75 and 90 volts. Below 40 volts, in this example, the curves become less steep. It will be noted from the figure that at zero grid voltage, for example, a plate current of about 0.1 milli-ampere, is indicated at 30 volts plate potential, while at 40 volts plate potential the plate current is about 0.25 milli-amperes.

It may be stated that one of the factors determining the plate current is the influence of the plate acting through the openings of the grid, which may be considered as the passage of lines of force from the plate through the grid. The characteristic curve described will be moved to the left, into the range of negative grid potentials, as the passage of lines of force through the grid increases. This effect occurs if the plate potential be kept constant and the meshes of the grid are increased in size, or if the meshes are kept the same size and the potential at the plate is increased. Conversely, of course, the characteristic is shifted to the right proportionately as the potential at the plate decreases.

To obtain high amplification it is desirable to operate within the range of negative potentials at the grid, as is well-known, a sufficiently negative grid meaning a high

ELECTRON TUBE

Filed April 4, 1921

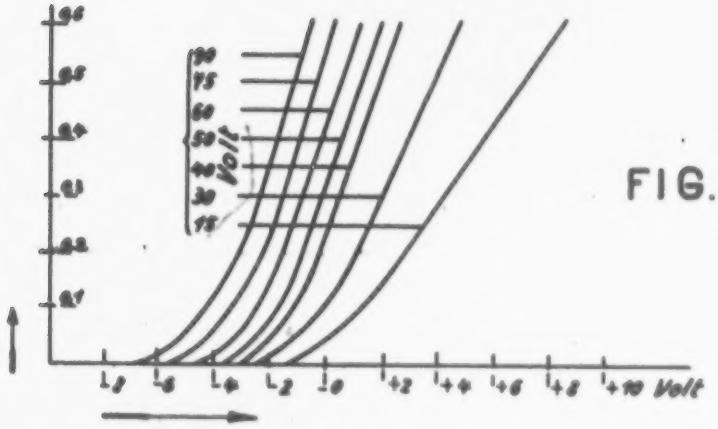


FIG. 1.

FIG. 2.

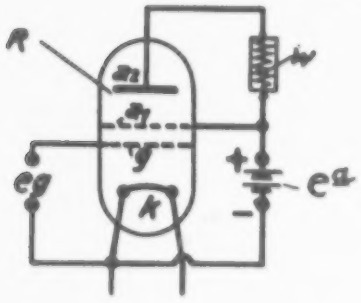
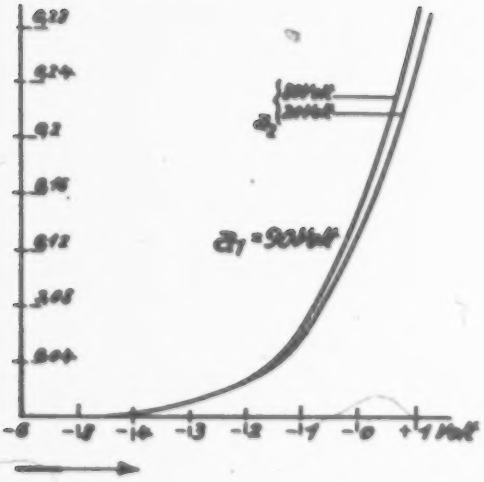


FIG. 3



INVENTORS:
JOSEPH MASSOLLE
HANS VOGT
JOSEF ENGL
BY Munn & Co.
ATTORNEYS

UNITED STATES PATENT OFFICE.

JOSEPH MASSOLLE, OF GRUNEWALD, HANS VOGT, OF BERLIN-SCHONEBERG, AND JOSEF ENGL, OF GRUNEWALD, GERMANY, ASSIGNORS TO TRI-ERGON LIMITED, OF ZURICH, SWITZERLAND.

ELECTRON TUBE.

Application filed April 4, 1921, Serial No. 458,635, and in Germany December 2, 1919.

The invention relates to electron tubes, particularly to thermionic amplifying tubes. The invention aims to improve the effectiveness in operation of amplifier tubes, by overcoming an effect, or action, in the operation of amplifiers of common type, which tends to reduce the amplifications secured thereby. In the operation of the well-known amplifier having an effective resistance in series with the plate-filament path of the tube, across the constant source of potential (B battery), of the tube, variation of input voltage causes a variation in the plate-filament potential difference. With grid potential increasing from negative to less negative the plate current will increase and the potential difference between plate and filament decreases. The operating conditions of the tube now correspond to a different current-voltage curve; and a comparison of curves plotted for different potentials at the plate will demonstrate that the amplification indicated by the second curve may be less than that indicated by the first curve.

The effectiveness of the tube will, of course be improved if a characteristic curve of desirable steepness be selected, and if such arrangements be provided that the operation will remain substantially on the same curve, regardless of varying potential differences between plate and filament. The present invention provides means for accomplishing this object, or, generally speaking, for reducing the effect of variations in the plate potential in varying the amplification factor of the tube. This is accomplished by the provision of an auxiliary anode, or anode screening member, preferably positioned between the plate or working anode and the grid, and connected to the constant potential source of the tube, preferably in such manner that the potential difference between this screening member and the filament is less than that between the plate or working anode of the tube, and the filament.

In order that the invention may be more clearly understood, attention is hereby called to the accompanying drawings, in which:—

Figure 1 is a diagram giving a series of characteristic curves for a usual type of amplifying tube, indicating the relations between grid potentials and plate current for varying plate potentials, the horizontal co-ordinate of the diagram indicating grid voltages and the vertical co-ordinate indicating plate current in milli-amperes, while the numerals at the left hand side of the curves indicate the plate potentials of the various curves, in volts;

Fig. 2 is a view of an electron discharge tube having an anode screening member, or auxiliary anode, in accordance with the present invention; and

Fig. 3 is a diagram of current voltage curves for the construction shown in Fig. 2, the horizontal co-ordinate indicating grid voltages, and the vertical co-ordinate indicating plate current in milli-amperes.

The curves shown in Figure 1 represent by way of example the relations between grid potentials and plate current for varying plate potentials, recorded with ordinary amplifier tubes, the right hand curve corresponding to 15 volts plate potential and the curves to the left thereof successively 30, 40, 50, 60, 75 and 90 volts. Below 40 volts, in this example, the curves become less steep. It will be noted from the figure that at zero grid voltage, for example, a plate current of about 0.1 milli-ampere, is indicated at 30 volts plate potential, while at 40 volts plate potential the plate current is about 0.25 milli-amperes.

It may be stated that one of the factors determining the plate current is the influence of the plate acting through the openings of the grid, which may be considered as the passage of lines of force from the plate through the grid. The characteristic curve described will be moved to the left, into the range of negative grid potentials, as the passage of lines of force through the grid increases. This effect occurs if the plate potential be kept constant and the meshes of the grid are increased in size, or if the meshes are kept the same size and the potential at the plate is increased. Conversely, of course, the characteristic is shifted to the right proportionately as the potential at the plate decreases.

To obtain high amplification it is desirable to operate within the range of negative potentials at the grid, as is well-known, a sufficiently negative grid meaning a high resistance between filament and grid and a relatively high plate current. To attain this, the plate voltage must be sufficiently high. In the example shown in Figure 1 the

curves have maximum steepness at plate voltages of 40 volts and upwards. It is, therefore, desirable to operate on curves of 40 volts plate potential and upwards.

It will be noted that in the operation of three electrode amplifying tubes of usual construction the working resistance outside the tube is connected in series with the plate-filament path of the tube and with the constant source (B-battery). If now, we assume, for example, that the grid potential becomes less negative momentarily because of changing conditions in the input circuit of the tube, the internal resistance of the tube between plate and filament then decreases and the plate circuit current increases. The drop of potential across the external resistance increases and the potential drop within the tube between plate and filament decreases. That is to say, the electrical conditions within the tube no longer correspond to the current-voltage curve which represented them before the change in input potential, but to another current-voltage curve situated further to the right in a diagram such as that of Figure 1, in which case the amplification may not be so good.

In the construction shown in Fig. 2 illustrating the present invention, the input circuit is connected across the grid g and the filament k as usual, variations in the input circuit causing a varying difference of potential eg across the grid and filament. The plate a^2 is shown as connected to the filament by an external connection which includes the resistance w and the source of steady plate current indicated as the battery ea.

The anode screening member a' is shown as connected to the positive pole of battery ea. Resistance w is included in the connection between plate a^2 and the positive pole of the battery, whereas this resistance is not included in the connection between the anode screen, or auxiliary plate, a' and the positive pole of the battery. Accordingly, this arrangement provides for a greater drop of potential between the anode screen a' and the filament, than exists between plate a^2 and the filament because of the drop of the potential through resistance w. The out-going circuit may be considered as connected across the terminals of resistance w.

In the arrangement shown, which is preferred, the anode screen a' is located between grid g and plate a^2. The potential supplied to anode screen a' by the battery or source ea is as nearly constant as possible. The effect of this screening or protecting electrode a' is to greatly decrease the electrostatic lines of force from the working anode or plate a^2 through the openings of voltage of the plate will have practically no effect in displacing the characteristic anode current curve, and, accordingly, good amplification may be obtained, with plate voltage varying within considerable limits, the electrical characteristics of the tube being so chosen that a desirably positioned and sufficiently steep curve is made use of. Instead of having the member a' interposed between the working plate and filament, it is possible to have members a' and a^2 arranged one beside the other, the arrangement shown, however, being preferred.

In the example shown, the varying voltage of plate a^2 has practically no influence on the range or position of the current-voltage curve of the tube. This is demonstrated by the curves shown in Fig. 4 which were obtained with a tube constructed according to the invention. A constant potential of 90 volts was applied to the anode screen or auxiliary anode a' while voltages of 20 volts and 80 volts respectively were applied to the working anode or plate a^2. It will be noted that both curves start from the same point on the horizontal co-ordinate and separate from each other very slightly in the course of the upward rise of the curves, showing that the varying voltage of the plate, in this arrangement, exerts very little influence on the position of the curve.

The screening member a' is preferably grid-like or perforated in form. When this member has small meshes or openings therethrough and there is a relatively large distance between members a' and a^2, a proportionately small number of electrons from the heated filament k will pass through the member a' and reach plate a^2. If, however, the meshes or the width of the openings in anode screen a' are increased, or if the distance between members a' and a^2 is reduced, the number of electrons passing through member a' to the plate a^2 becomes relatively greater. As an extreme example, the anode screen a' may be reduced to consist of a single wire only, in which case its surface becomes very small in comparison with that of plate a^2, and in that case a considerable part of the electrons emitted by the cathode will pass to plate a^2.

It will be noted that as shown in the example in Fig. 2, the full potential of battery ea is applied constantly to the anode screen a', while the potential at plate a^2 is reduced by the amount of the potential drop across the resistance w. The potential of battery ea may be divided, by means of a potentiometer or otherwise as desired to produce other relations than those shown between the potentials at members a' and a^2, the only essential requirement, for best operation, being the fulfillment of the condition

We claim:—

1. In electron discharge tubes, the combination of a vacuous tube having plate, grid and filament, and anode screening means, an input circuit connected to the grid and filament, a source of potential, and connections therefrom to the plate, filament and screening means, including greater resistance between said source and plate than between said source and screening means, for imposing a greater potential difference between said screening means and filament than between said plate and filament.

2. In electron discharge tubes, the combination of a vacuous tube having plate, grid and filament, and anode screening means, an input circuit connected to the grid and filament, a source of potential, having its negative terminal connected to the filament, a resistance connected in series between the plate and the positive terminal of the source, and a connection between said screening means and a point between the positive pole of the source and the resistance.

3. In electron discharge tubes, the combination of a vacuous tube having plate, grid and filament, and anode screening means interposed between the plate and grid output terminals connected to said plate and filament, an input circuit connected to the grid and filament, a source of potential, and connections therefrom to said output terminals and screening means, including an impedance in the connection to one of said output terminals, for imposing a greater potential difference between said screening means and filament than between said plate and filament.

4. In electron discharge tubes, the combination of a vacuous tube having anode, cathode and control electrode, and anode screening means, means for impressing a varying potential across the cathode and control electrode, a source of steady potential connected between the anode and cathode, a connection between the positive side of said source and said anode screening means, and means interposed between said source and anode for reducing the potential difference between the anode and cathode due to said source.

5. In electron discharge tubes, the combination of a vacuous tube having anode, cathode and control electrode, and anode screening means, means for impressing a varying potential across the cathode and control electrode, said anode screening means being interposed between said anode and control electrode connections external to the tube between the anode and cathode, and means for imposing a potential difference between said anode and cathode and a steady, relatively great, potential difference between said anode screening means and said cathode.

6. In electron discharge tubes, the combination of a vacuous tube having anode, cathode and control electrode, and anode screening means, means for impressing a varying potential across the cathode and control electrode, external means for producing a steady potential, and connections therefrom to said anode, cathode and screening means for imposing a greater potential difference between said screening means and cathode, than between said anode and cathode, said connections including an impedance providing for a drop of potential between said potential producing means and the anode-cathode path of the tube.

In testimony whereof we affix our signatures.

JOSEPH MASSOLLE.
HANS VOGT.
Dr. JOSEF ENGL.

voltage of 40 volts and upwards. It is, therefore, desirable to operate on curves of 40 volts plate potential and upwards.

It will be noted that in the operation of three electrode amplifying tubes of usual construction the working resistance outside the tube is connected in series with the plate-filament path of the tube and with the constant source (B-battery). If now, we assume, for example, that the grid potential becomes less negative momentarily because of changing conditions in the input circuit of the tube, the internal resistance of the tube between plate and filament then decreases and the plate circuit current increases. The drop of potential across the external resistance increases and the potential drop within the tube between plate and filament decreases. That is to say, the electrical conditions within the tube no longer correspond to the current-voltage curve which represented them before the change in input potential, but to another current-voltage curve situated further to the right in a diagram such as that of Figure 1, in which case the amplification may not be so good.

In the construction shown in Fig. 2 illustrating the present invention, the input circuit is connected across the grid g and the filament k as usual, variations in the input circuit causing a varying difference of potential eg across the grid and filament. The plate a^2 is shown as connected to the filament by an external connection which includes the resistance w and the source of steady plate current indicated as the battery ea.

The anode screening member a' is shown as connected to the positive pole of battery ea. Resistance w is included in the connection between plate a^2 and the positive pole of the battery, whereas this resistance is not included in the connection between the anode screen, or auxiliary plate, a' and the positive pole of the battery. Accordingly, this arrangement provides for a greater drop of potential between the anode screen a' and the filament, than exists between plate a^2 and the filament because of the drop of the potential through resistance w. The out-going circuit may be considered as connected across the terminals of resistance w.

In the arrangement shown, which is preferred, the anode screen a' is located between grid g and plate a^2. The potential supplied to anode screen a' by the battery or source ea is as nearly constant as possible. The effect of this screening or protecting electrode a' is to greatly decrease the electrostatic lines of force from the working anode or plate a^2 through the openings of the grid. By decreasing this flux through the grid to a minimum variation in the effect in displacing the characteristic anode current curve, and, accordingly, good amplification may be obtained, with plate voltage varying within considerable limits, the electrical characteristics of the tube being so chosen that a desirably positioned and sufficiently steep curve is made use of. Instead of having the member a' interposed between the working plate and filament, it is possible to have members a' and a^2 arranged one beside the other, the arrangement shown, however, being preferred.

In the example shown, the varying voltage of plate a^2 has practically no influence on the range or position of the current-voltage curve of the tube. This is demonstrated by the curves shown in Fig. 4 which were obtained with a tube constructed according to the invention. A constant potential of 90 volts was applied to the anode screen or auxiliary anode a' while voltages of 20 volts and 80 volts respectively were applied to the working anode or plate a^2. It will be noted that both curves start from the same point on the horizontal co-ordinate and separate from each other very slightly in the course of the upward rise of the curves, showing that the varying voltage of the plate, in this arrangement, exerts very little influence on the position of the curve.

The screening member a' is preferably grid-like or perforated in form. When this member has small meshes or openings therethrough and there is a relatively large distance between members a' and a^2, a proportionately small number of electrons from the heated filament k will pass through the member a' and reach plate a^2. If, however, the meshes or the width of the openings in anode screen a' are increased, or if the distance between members a' and a^2 is reduced, the number of electrons passing through member a' to the plate a^2 becomes relatively greater. As an extreme example, the anode screen a' may be reduced to consist of a single wire only, in which case its surface becomes very small in comparison with that of plate a^2, and in that case a considerable part of the electrons emitted by the cathode will pass to plate a^2.

It will be noted that as shown in the example in Fig. 2, the full potential of battery ea is applied constantly to the anode screen a', while the potential at plate a^2 is reduced by the amount of the potential drop across the resistance w. The potential of battery ea may be divided, by means of a potentiometer or otherwise as desired to produce other relations than those shown between the potentials at members a' and a^2, the only essential requirement, for best operation, being the fulfillment of the condition that the potential on plate a^2 must be less than that on the anode screen a'.

We claim:—

1. In electron discharge tubes, the combination of a vacuous tube having plate, grid and filament, and anode screening means, an input circuit connected to the grid and filament, a source of potential, and connections therefrom to the plate, filament and screening means, including greater resistance between said source and plate than between said source and screening means, for imposing a greater potential difference between said screening means and filament than between said plate and filament.

2. In electron discharge tubes, the combination of a vacuous tube having plate, grid and filament, and anode screening means, an input circuit connected to the grid and filament, a source of potential, having its negative terminal connected to the filament, a resistance connected in series between the plate and the positive terminal of the source, and a connection between said screening means and a point between the positive pole of the source and the resistance.

3. In electron discharge tubes, the combination of a vacuous tube having plate, grid and filament, and anode screening means interposed between the plate and grid output terminals connected to said plate and filament, an input circuit connected to the grid and filament, a source of potential, and connections therefrom to said output terminals and screening means, including an impedance in the connection to one of said output terminals, for imposing a greater potential difference between said screening means and filament than between said plate and filament.

4. In electron discharge tubes, the combination of a vacuous tube having anode, cathode and control electrode, and anode screening means, means for impressing a varying potential across the cathode and control electrode, a source of steady potential connected between the anode and cathode, a connection between the positive side of said source and said anode screening means, and means interposed between said source and anode for reducing the potential difference between the anode and cathode due to said source.

5. In electron discharge tubes, the combination of a vacuous tube having anode, cathode and control electrode, and anode screening means, means for impressing a varying potential across the cathode and control electrode, said anode screening means being interposed between said anode and control electrode connections external to the tube between the anode and cathode, and means for imposing a potential difference between said anode and cathode and a steady, relatively great, potential difference between said anode screening means and said cathode.

6. In electron discharge tubes, the combination of a vacuous tube having anode, cathode and control electrode, and anode screening means, means for impressing a varying potential across the cathode and control electrode, external means for producing a steady potential, and connections therefrom to said anode, cathode and screening means for imposing a greater potential difference between said screening means and cathode, than between said anode and cathode, said connections including an impedance providing for a drop of potential between said potential producing means and the anode-cathode path of the tube.

In testimony whereof we affix our signatures.

JOSEPH MASSOLLE.
HANS VOGT.
Dr. JOSEF ENGL.

PLAINTIFFS' EXHIBIT NO. 27-A.

Glühkathode der letzten Verstärkerröhre. Diese Verbindung hat den Zweck, den Belegungen der elektrostatischen Telephone die an den Verstärkungskreisen liegende Spannungsdifferenz von 720 Volt auch als mittlere Vorspannung zuzuführen. Um diesen Betrag von 720 Volt schwankt, verursacht durch die variable Belichtung der photoelektrischen Zelle, die Spannungsdifferenz zwischen den Belegen der elektrostatischen Telephone und ruft entsprechende Schallbewegung der benachbarten Luft hervor, wie weiter unten auseinandergesetzt.

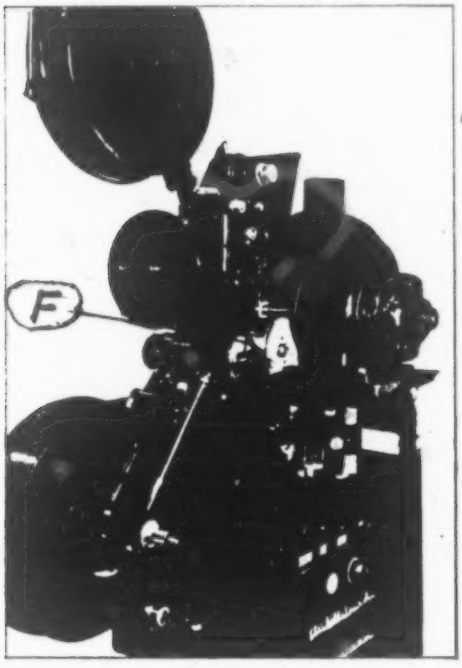


Fig. 44. Antriebsvorrichtung bei der Wiedergabe.

In den beigegebenen Fig. 43 bis 46 findet man Gesamt- und Einzelbilder des Wiedergabeapparates In Fig. 43 sind klar ersichtlich die Gehäuse, in denen die Filmtrommeln um eine Achse rotieren können, so daß der Film von einer Trommel abgespult, an der Bild- und Tonabnahmestelle vorbeigeführt und in der unteren Filmtrommel wieder aufgespult werden kann. Im Gehäuse befindet sich die Projektionsbogenlampe für die Bildprojektion, im Unterbau des Apparates der Verstärker und die für die Verstärkung nötigen Spannungsquellen (kleine Akkumulatoren für die Hochspannung, größere Akkumulatoren für die Heizung der Glühfäden der Verstärkerröhre und der Beleuchtungslampe für die Tonwiedergabe). Neben dem Wiedergabeapparat stehen vier elektrostatische Lautsprecher, auf ihnen das Regulierpotentiometer zur Veränderung der Lautstärke. Beides wird im Betrieb durch Leitung mit der Verstärkungseinrichtung verbunden.

U. S. DISTRICT COURT
M. D. PENN.
COMPL. EX. 27 A

In Fig. 45 sind die näheren Einzelheiten der Wiedergabeeinrichtung besser zu sehen. Die Bahn, in welcher der Film bei seinem Transport durch den Apparat läuft, ist klar erkennbar. Aus der oberen Filmtrommel läuft der Film heraus über eine der üblichen gezahnten Transportrollen durch das sogenannte Bildfenster, in dem der Film intermittierend stehenbleibt, um dann durch das Maltheserkreuzgetriebe ruckartig weitergeführt

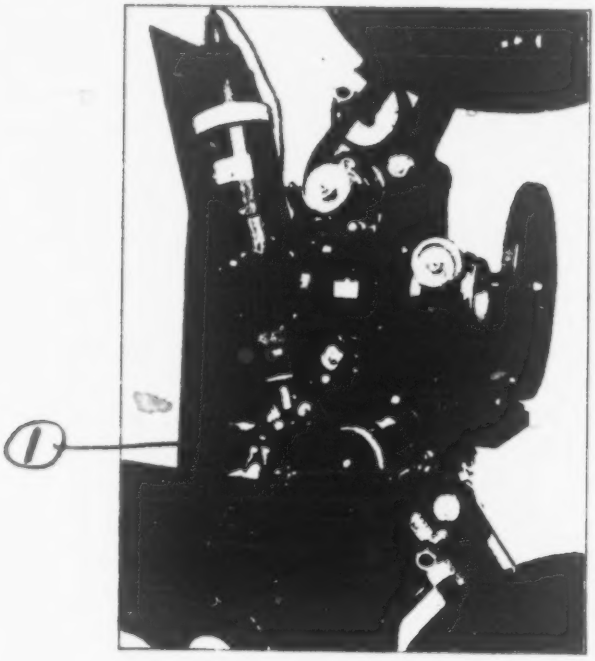


Fig. 45.
Laufbahn des Filmbandes durch die Wiedergabeeinrichtung.

zu werden. Der Film läuft sodann durch eine weitere Transportrolle, macht eine kleine lose Schleife, um für die ruckweise Bewegung Spielraum zu geben und läuft sodann über eine gezahnte Transportrolle, die hohl ausgeführt ist. Schließlich verschwindet er in der Aufwicklungsrolle unten. Die letztgenannte Hohlzahntrommel ist so ausgeführt, daß der Rand des Filmbandes, der die Tonzeichnungen trägt, am Rande der Trommel frei übersteht. Hier wird er von einer Lichtquelle, die sich am oberen Ende des Tubus befindet, vermittelst eines optischen Systems in einer feinen

U. S. DISTRICT COURT
M. D. PENN.
COMPL. EX. 27 B

PLAINTIFFS' EXHIBIT NO. 28.

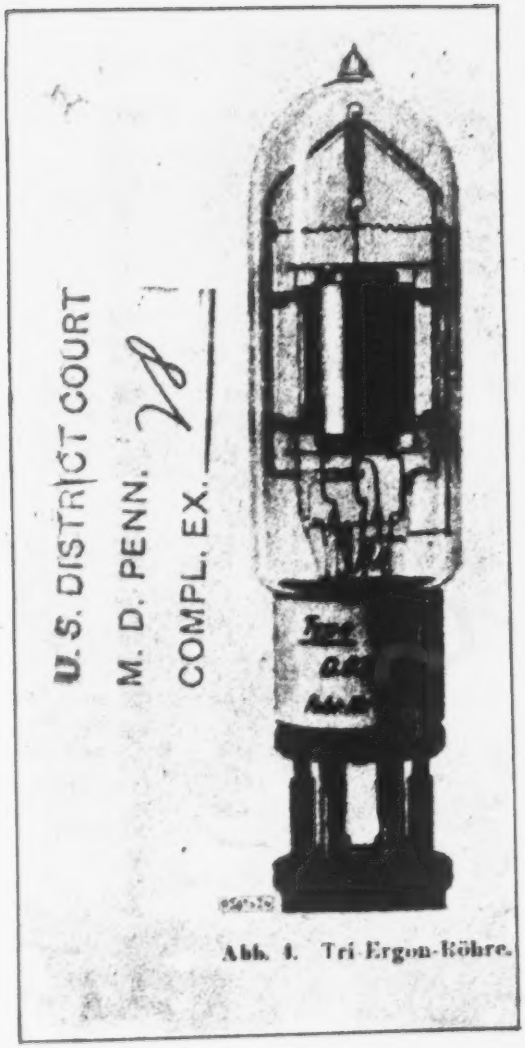
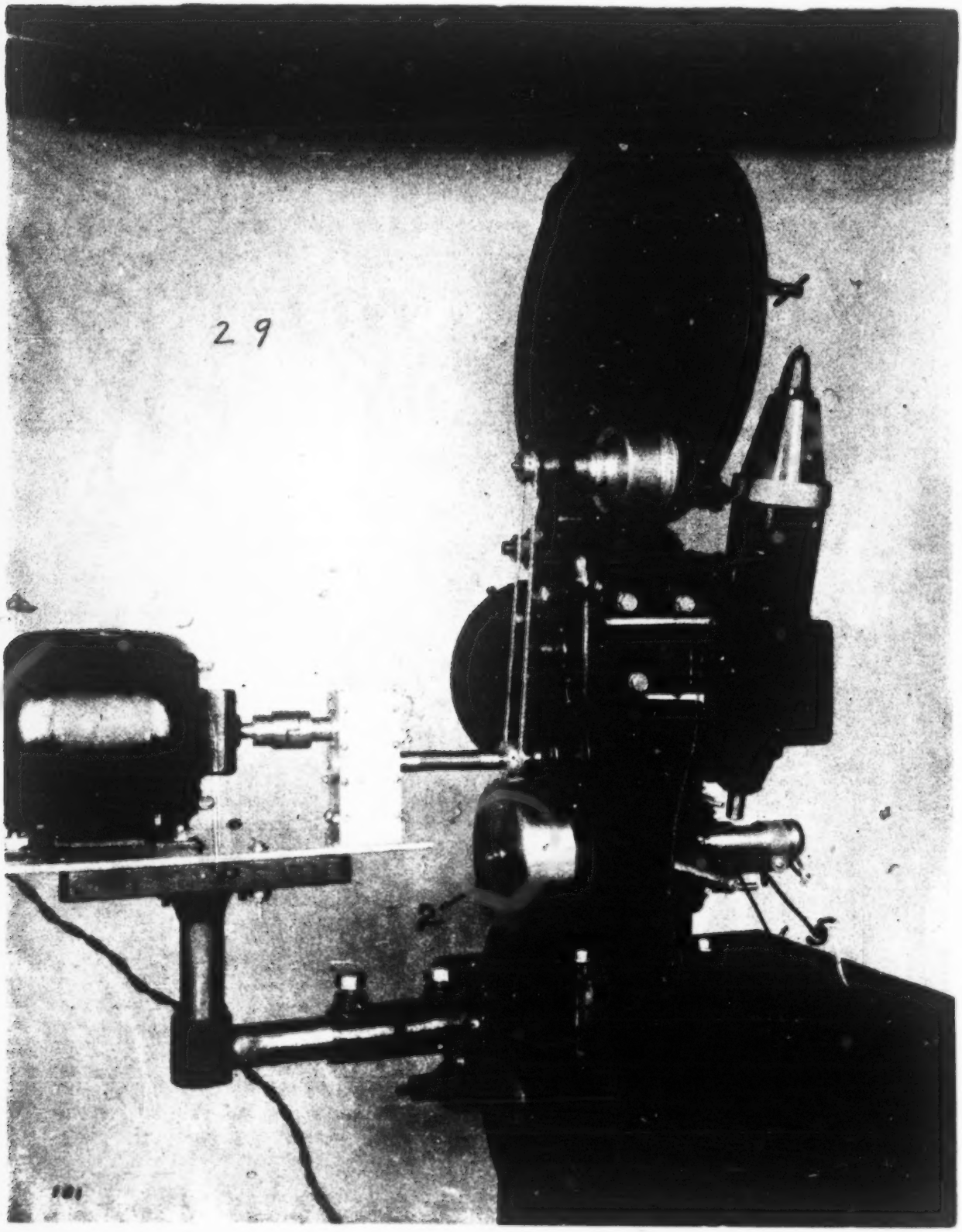
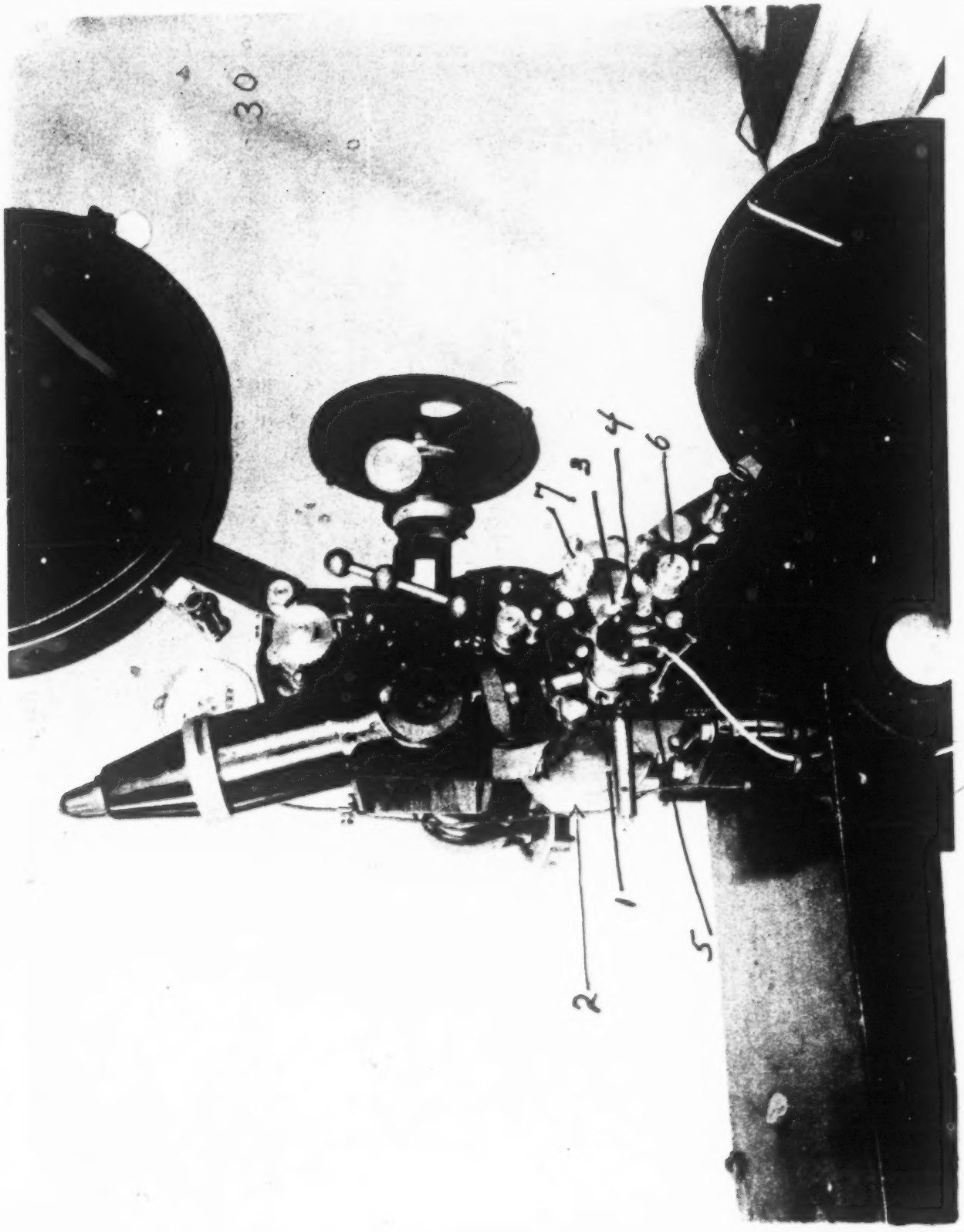


Abb. 4. Tri-Ergon-Röhre.

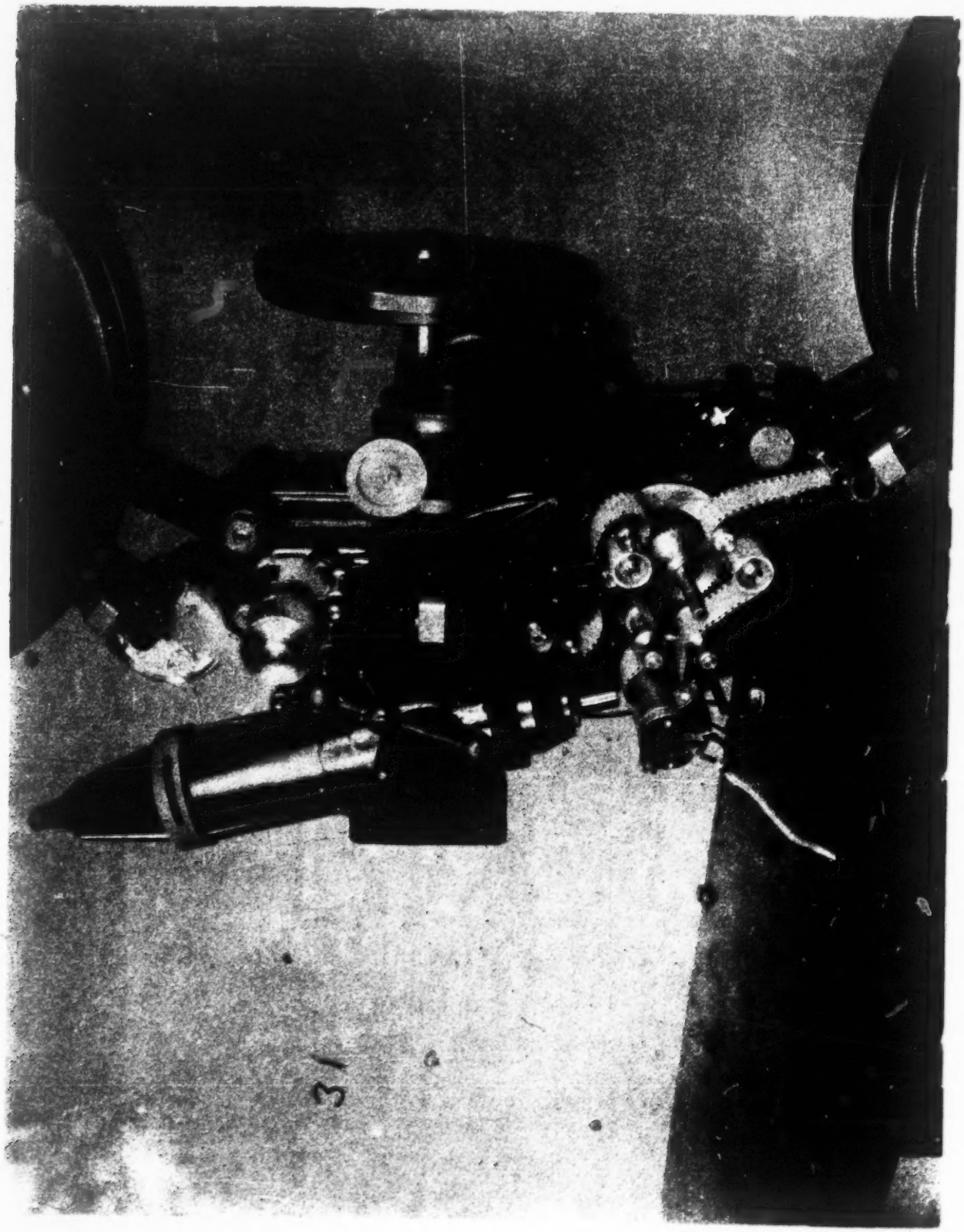
PLAINTIFFS' EXHIBIT NO. 29.



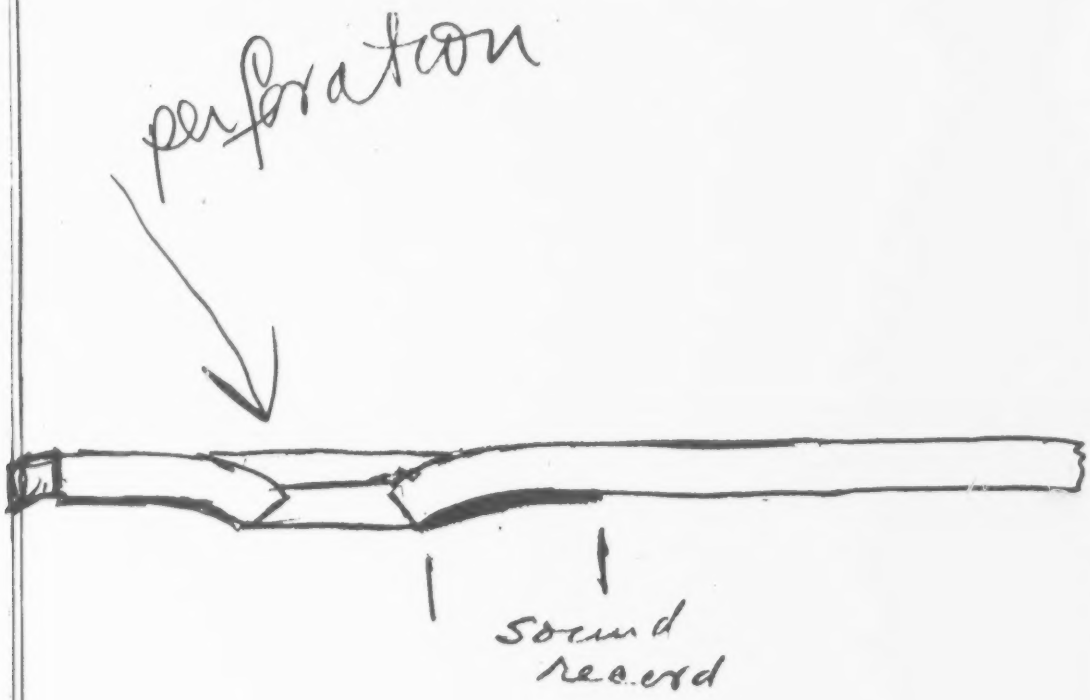
PLAINTIFFS' EXHIBIT NO. 30.



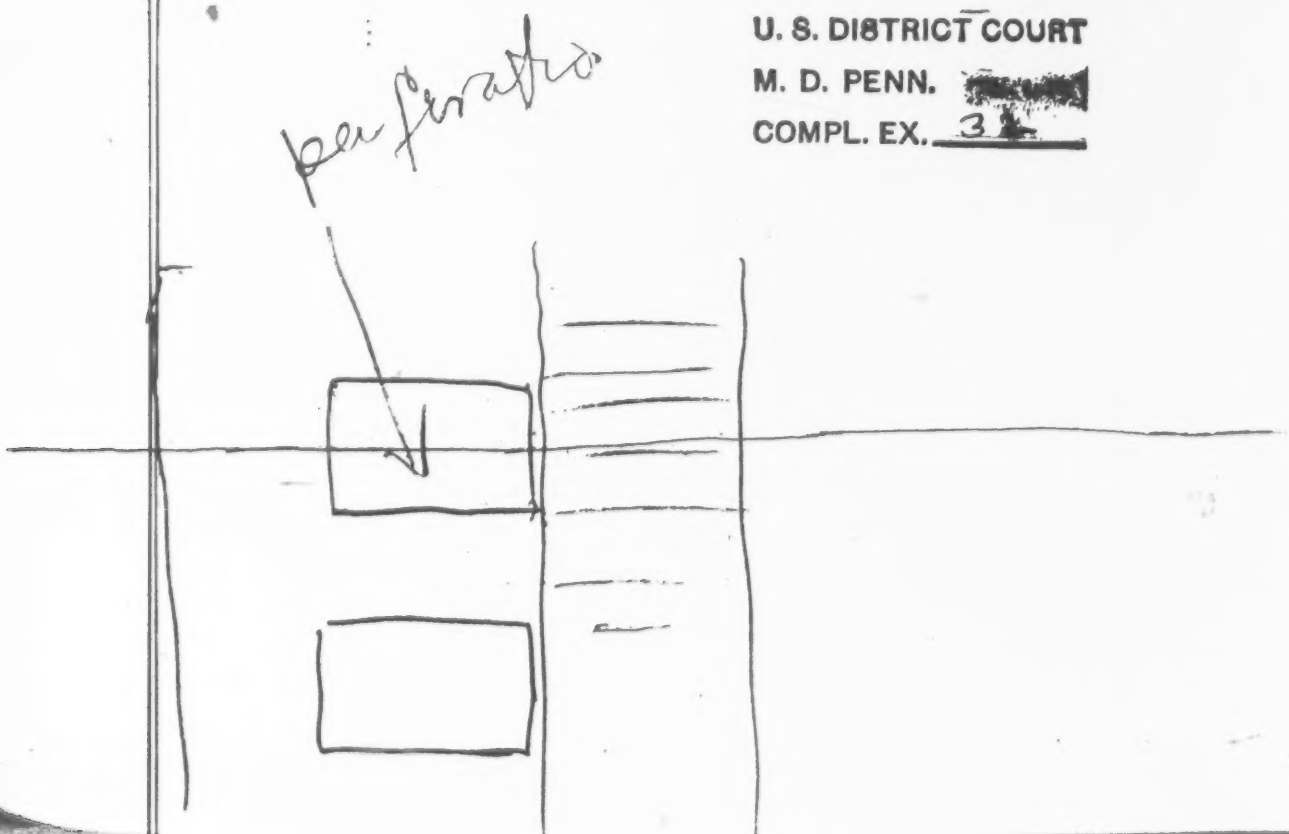
PLAINTIFFS' EXHIBIT NO. 31.

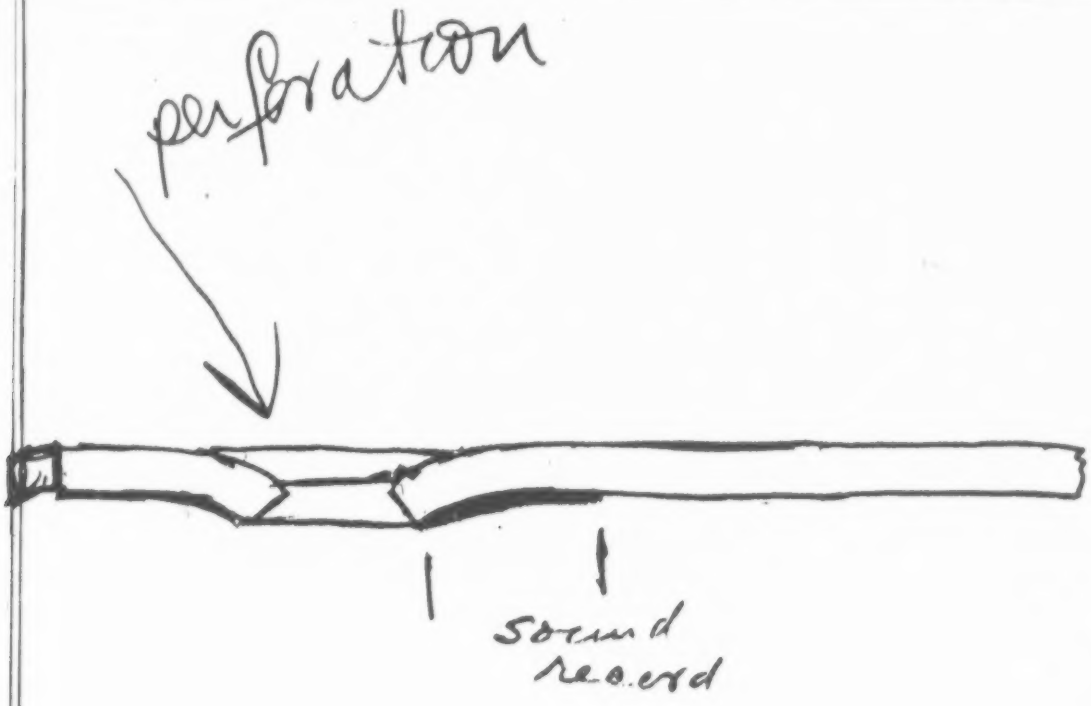


PLAINTIFFS' EXHIBIT NO. 32.

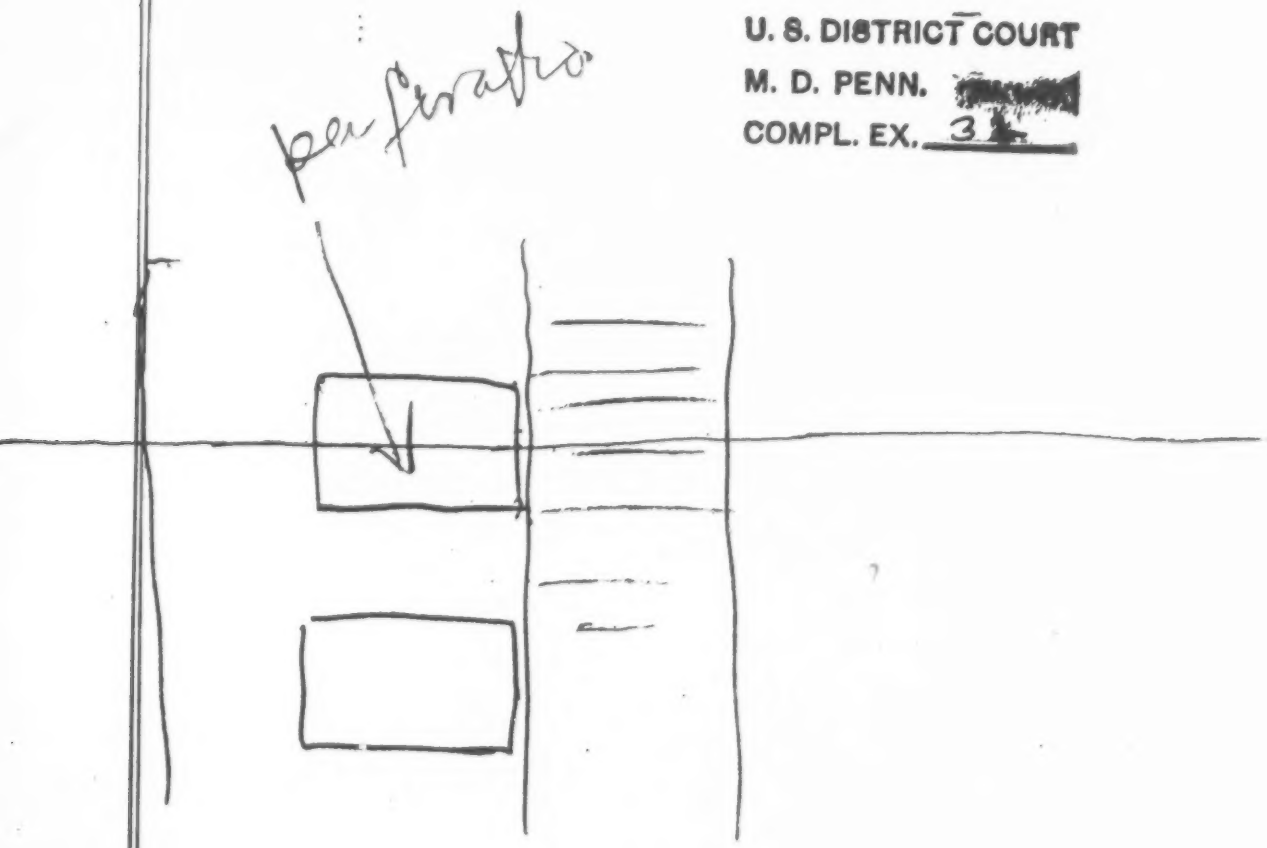


U. S. DISTRICT COURT
M. D. PENN.
COMPL. EX. 3





U. S. DISTRICT COURT
M. D. PENN.
COMPL. EX. 31



PLAINTIFFS' EXHIBIT NO. 33.

Sample Vogt, et al., Flywheel from One of 25 Vogt, et al., Machines, and of the Same Shape and Design as Brought to U. S. by Dr. Engl in 1926-1927.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 34-A.

Page 1, Vol. 6, Senate Documents, First Session 67th Congress, Comprising Message from the President to the U. S. Senate Re Treaty of Berlin.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 34-B.

Page 11 to End of Volume of Above Vol. 6, Comprising Versailles Treaty.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 34-C.

Government Publication, "Treaty Series No. 658 Re Treaty of Berlin and Treaty of Versailles."

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 34-D.

Congressional Record, Vol. 61, No. 131 of 1921, pages 7113-7116; 7121-7122; and Vol. 61, No. 132, page 7173, Comprising Debates Re Treaty of Berlin.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 35.

United States Patent No. 1,817,781.

364

Aug. 4, 1931. O. STEINER 1,817,781

SOUND REPRODUCING APPARATUS

Original Filed July 5, 1927

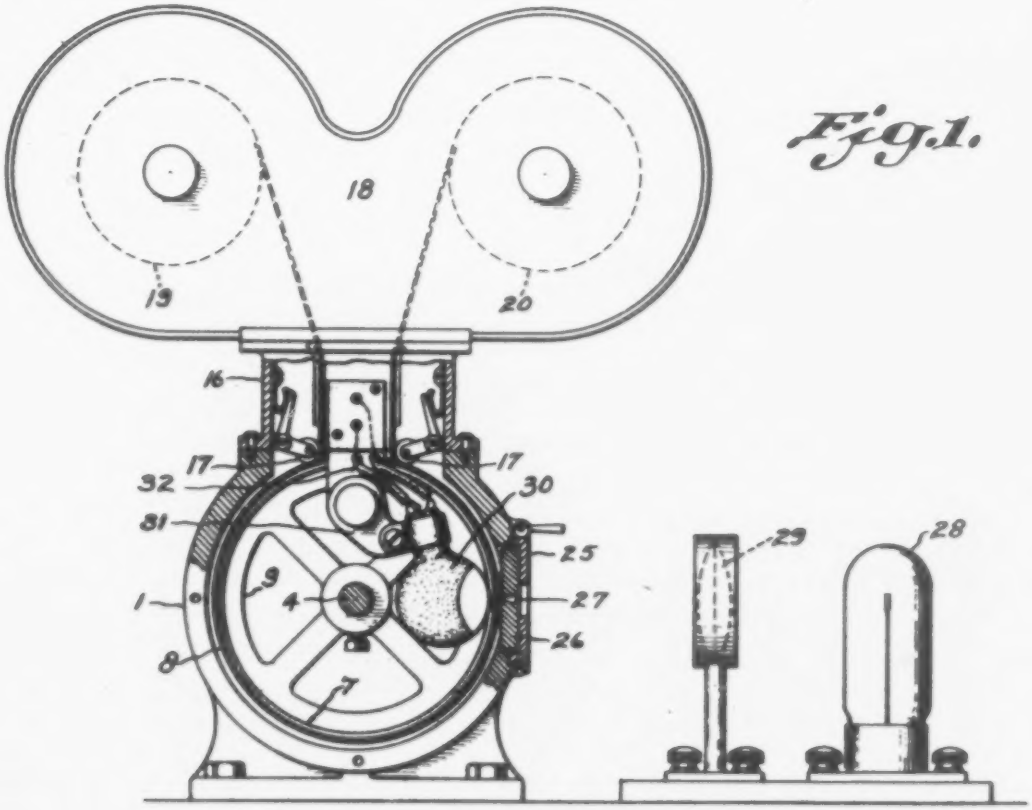


Fig. 1.

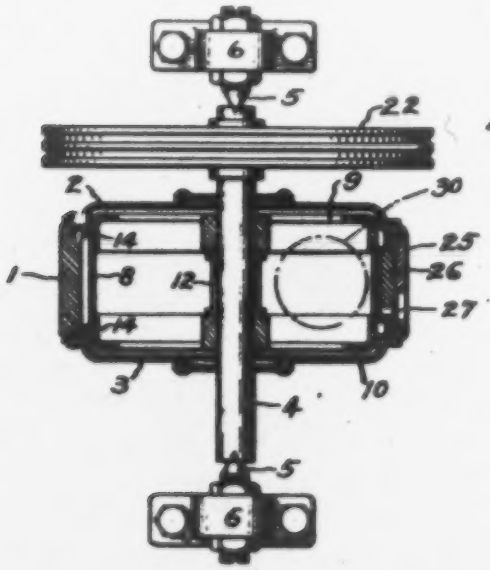


Fig. 2.

Inventor
Oscar Steiner.

Patented Aug. 4, 1931

1,817,781

UNITED STATES PATENT OFFICE

OSCAR STEINER, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

SOUND REPRODUCING APPARATUS

Application filed July 5, 1927, Serial No. 203,353. Renewed October 16, 1929.

My invention relates to the reproduction of sound from a photographic record on a moving film and particularly to the manner of supporting and guiding the moving film.

Prior to my invention the moving film bearing the sound record usually was drawn through a straight guide where a narrow light beam was directed through the sound record over the film into a photo-electric cell. A common means of limiting the light beam to the desired narrow width was by interposing in its path an opaque screen having an extremely thin transparent line or aperture therein. For the best results the film should run very close to the screen, yet to avoid scratching of the record it should not actually touch the screen or other stationary parts. A film strip having an emulsion on one side thereof when unrestrained naturally curls to a certain extent transversely with the emulsion side inward and this curling of the film has increased the difficulty of moving the film through the apparatus close to the apertured screen without danger of its being scratched. It is an object of my invention to provide improved means for supporting and guiding the film whereby as it passes through the light beam it maintains laterally a relatively fixed position.

In accordance with my invention I provide a drum having a circumferential opening therein for supporting and guiding the film and mount the photo-electric cell in a position to receive a light beam passing through the film record and the circumferential opening in the drum.

My invention will be better understood from the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

Referring to the drawings, Fig. 1 is a side elevation partly in section of apparatus embodying my invention and Fig. 2 is a top plan view of the same also partly in section.

mounted in the pillars 6. The drum 7 by which the film 8 is supported and guided comprises two similar spaced, complementary members 9 and 10 each fixed on the shaft 4 together with the spacer 12. At least one of these members, for example member 10, is adapted to be loosened and slid along the shaft after first removing the adjacent end plate 3 for gaining access to the interior of the drum. The two members 9 and 10 have peripheral flanges 14 which face each other and which are shown in the present embodiment as spaced apart a distance nearly equal to the width of the film. The flanges 14 are shown each having an annular recess which receives an edge of the film, care being taken in the construction to have the bottom of each recess run true when the shaft is rotated.

On the top of the base 1 is fastened the member 16 having suitable openings for the passage of the film and having the spring pressed rollers 17 which in pressing the film against the drum assist in preventing slippage of the film thereon. Above the member 16 is the magazine 18 containing the film reels 19 and 20. For rotating the drum the shaft is provided with a suitable belt or gear drive, the former being shown for convenience comprising the pulley 22 over which may pass a belt to a motor or other source of power. One or both of the reels 19 and 20 preferably are driven also as for example by a connection with the pulley 22 which connection has been omitted from the drawing to avoid unnecessary complication. The base 1 at one side thereof is shown provided with a detachable holder 25 into which slides the aperture containing plate 26 having a very narrow light aperture 27 positioned opposite the sound record on the film. The plate 26 does not touch the moving film but is arranged very close to it. In front of the aperture is mounted a suitable source of light 28 and a condensing lens 29 is arranged to direct an intense light beam on the aperture. Within the drum and opposite the

SOUND REPRODUCING APPARATUS

Original Filed July 5, 1927

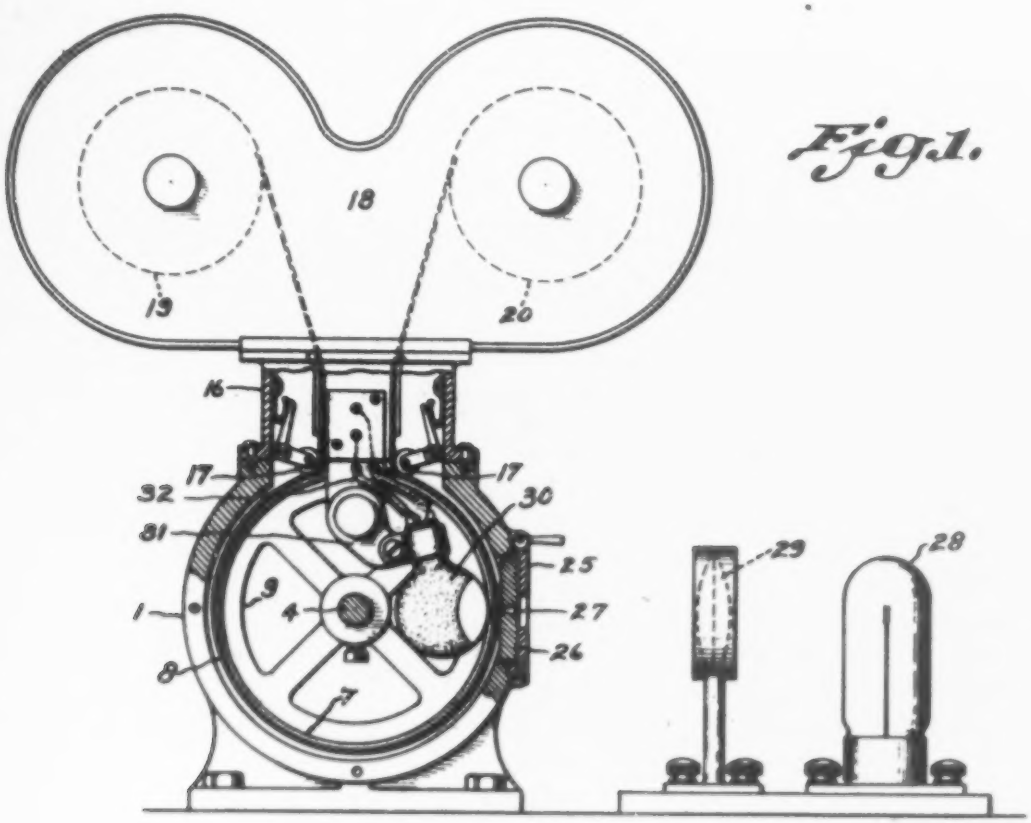


Fig. 1.

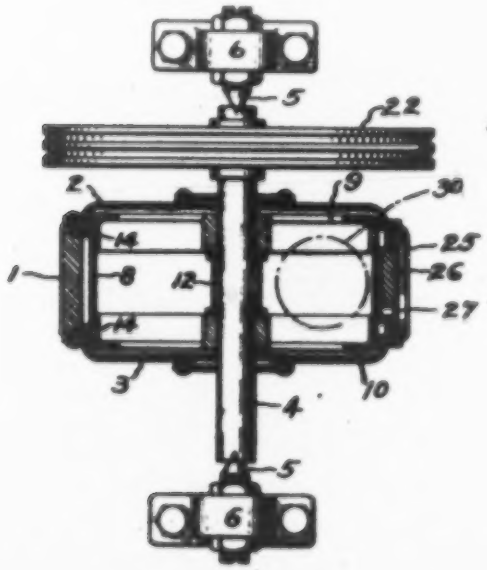


Fig. 2.

Inventor
Oscar Steiner,
by Alexander S. Lewis
His Attorney.

UNITED STATES PATENT OFFICE

OSCAR STEINER, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

SOUND REPRODUCING APPARATUS

Application filed July 5, 1927, Serial No. 203,353. Renewed October 16, 1929.

My invention relates to the reproduction of sound from a photographic record on a moving film and particularly to the manner of supporting and guiding the moving film.

Prior to my invention the moving film bearing the sound record usually was drawn through a straight guide where a narrow light beam was directed through the sound record over the film into a photo-electric cell. A common means of limiting the light beam to the desired narrow width was by interposing in its path an opaque screen having an extremely thin transparent line or aperture therein. For the best results the film should run very close to the screen, yet to avoid scratching of the record it should not actually touch the screen or other stationary parts. A film strip having an emulsion on one side thereof when unrestrained naturally curls to a certain extent transversely with the emulsion side inward and this curling of the film has increased the difficulty of moving the film through the apparatus close to the apertured screen without danger of its being scratched. It is an object of my invention to provide improved means for supporting and guiding the film whereby as it passes through the light beam it maintains laterally a relatively fixed position.

In accordance with my invention I provide a drum having a circumferential opening therein for supporting and guiding the film and mount the photo-electric cell in a position to receive a light beam passing through the film record and the circumferential opening in the drum.

My invention will be better understood from the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

Referring to the drawings, Fig. 1 is a side elevation partly in section of apparatus embodying my invention and Fig. 2 is a top plan view of the same also partly in section.

The hollow base 1 having detachable end plates 2 and 3 has mounted concentrically therein the drum supporting shaft 4 the same being shown journalled on the points 5 mounted in the pillars 6. The drum 7 by which the film 8 is supported and guided comprises two similar spaced, complementary members 9 and 10 each fixed on the shaft 4 together with the spacer 12. At least one of these members, for example member 10, is adapted to be loosened and slid along the shaft after first removing the adjacent end plate 3 for gaining access to the interior of the drum. The two members 9 and 10 have peripheral flanges 14 which face each other and which are shown in the present embodiment as spaced apart a distance nearly equal to the width of the film. The flanges 14 are shown each having an annular recess which receives an edge of the film, care being taken in the construction to have the bottom of each recess run true when the shaft is rotated.

On the top of the base 1 is fastened the member 16 having suitable openings for the passage of the film and having the spring pressed rollers 17 which in pressing the film against the drum assist in preventing slippage of the film thereon. Above the member 16 is the magazine 18 containing the film reels 19 and 20. For rotating the drum the shaft is provided with a suitable belt or gear drive, the former being shown for convenience comprising the pulley 22 over which may pass a belt to a motor or other source of power. One or both of the reels 19 and 20 preferably are driven also as for example by a connection with the pulley 22 which connection has been omitted from the drawing to avoid unnecessary complication. The base 1 at one side thereof is shown provided with a detachable holder 25 into which slides the aperture containing plate 26 having a very narrow light aperture 27 positioned opposite the sound record on the film. The plate 26 does not touch the moving film but is arranged very close to it. In front of the aperture is mounted a suitable source of light 28 and a condensing lens 29 is arranged to direct an intense light beam on the aperture. Within the drum and opposite the aperture is the photo-electric cell 30 mounted in a fixed position by the bracket 31 which is secured to the member 16 and extends through the circumferential opening of the

drum formed by the spacing of the drum members 9 and 10. The leads 32 of the cell also extend through the same opening to binding posts or other external connections.

With the apparatus as so arranged a light beam from the source 28 is concentrated on the aperture in plate 26 and a portion thereof controlled by the sound record on the moving film passes on through the space between the members 9 and 10 into the photo-electric cell 30. The drum thereby provides a firm support and guide for the film maintaining all portions thereof in exact position relative to the plate 26 and the aperture therein, yet it offers no obstruction to the light passing through the record on the film.

Although I have shown in the apparatus illustrated a plate having a narrow aperture for defining the narrow light beam which passes through the film, my invention is not limited to such apparatus but also is adapted for use where other means, for example an optical focusing means, are employed for defining the narrow light beam and which also require that that portion of the film passing the light beam shall remain in a relatively fixed position laterally.

I have chosen the particular embodiment described above as illustrative of my invention and it will be apparent that various modifications may be made without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In apparatus for reproducing sound from a film record, a rotatable drum for supporting a record film having a circumferential opening therein adapted to be bridged by the film, said drum having means for securing together in fixed relation the parts thereof on opposite sides of said opening, and a photo-electric cell arranged to receive light passing through said opening and the film bridging the same.

2. In apparatus for reproducing sound from a film record, a rotatable drum comprising portions separated axially by an opening and adapted to support a film at opposite sides of a sound record thereon, a connecting member common to both of said portions, a photo-electric cell and means for supporting the cell in a position to receive light passing through the record and through the opening between the drum portions.

3. In apparatus for reproducing sound from a film record, a rotatable drum for supporting a record film having a circumferential opening therein adapted to be bridged by the film and a photo-electric cell arranged

4. In apparatus for reproducing sound from a film record, a shaft, a film supporting drum mounted thereon comprising axially spaced complementary members, means for rotating the drum, a photo-electric cell, and means for supporting the cell in a fixed position within the drum and opposite the space between the members.

5. In apparatus for reproducing sound from a film record, a rotatable shaft, a film supporting drum mounted thereon comprising two axially spaced complementary portions one of said portions being movable along the shaft, a photo-electric cell within the drum and a support therefor extending through the space separating the two portions of the drum.

6. In apparatus for reproducing sound from a moving film having a sound record thereon, means comprising a drum for supporting the film, a photo-electric cell, and means for directing a light beam through the sound record into the photo-electric cell, the supporting means having an opening adapted to be bridged by the film and being constructed to support the film in a curved path at the point of intersection of the light beam therewith and at both sides of the sound record when passing said point, the portion of said supporting means at opposite sides of said opening being in fixed relation with each other.

7. In apparatus for reproducing sound from a moving film having a sound record thereon, an arcuate film supporting member curved in the direction of movement of the film and having portions in fixed relation with each other for engagement with the film on opposite sides of the sound record, a photo-electric cell, and means for directing a light beam through the sound record into said cell, said film supporting member having an opening therein to permit the free passage of the light beam therethrough.

8. In apparatus for reproducing sound from a moving film having a sound record thereon, a photo-electric cell, a source of light, means for directing a beam from said source through said record into said cell, and a member constructed and arranged to support the film in a longitudinally curved path at the point of intersection of the light beam therewith, said member having arcuate portions separated laterally by an open space for engaging the film at both sides of the sound record, and having means rigidly securing said portions together, the light beam being adapted to pass through the open space between said portions.

In witness whereof, I have hereunto set my hand this 1st day of July, 1927.

PLAINTIFFS' EXHIBIT NO. 36.

Copy of File Wrapper and Contents of Application for Above Steiner Patent (Marked for Identification, R. p. 1124).

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 37.

Sketch Made by Witness Tschopp (Defendants' Exhibit No. 49). (For Identification.)

(Shown at Page 701 of this Record.)

drum formed by the spacing of the drum members 9 and 10. The leads 32 of the cell also extend through the same opening to binding posts or other external connections.

With the apparatus as so arranged a light beam from the source 28 is concentrated on the aperture in plate 26 and a portion thereof controlled by the sound record on the moving film passes on through the space between the members 9 and 10 into the photo-electric cell 30. The drum thereby provides a firm support and guide for the film maintaining all portions thereof in exact position relative to the plate 26 and the aperture therein, yet it offers no obstruction to the light passing through the record on the film.

Although I have shown in the apparatus illustrated a plate having a narrow aperture for defining the narrow light beam which passes through the film, my invention is not limited to such apparatus but also is adapted for use where other means, for example an optical focusing means, are employed for defining the narrow light beam and which also require that that portion of the film passing the light beam shall remain in a relatively fixed position laterally.

I have chosen the particular embodiment described above as illustrative of my invention and it will be apparent that various modifications may be made without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In apparatus for reproducing sound from a film record, a rotatable drum for supporting a record film having a circumferential opening therein adapted to be bridged by the film, said drum having means for securing together in fixed relation the parts thereof on opposite sides of said opening, and a photo-electric cell arranged to receive light passing through said opening and the film bridging the same.

2. In apparatus for reproducing sound from a film record, a rotatable drum comprising portions separated axially by an opening and adapted to support a film at opposite sides of a sound record thereon, a connecting member common to both of said portions, a photo-electric cell and means for supporting the cell in a position to receive light passing through the record and through the opening between the drum portions.

3. In apparatus for reproducing sound from a film record, a rotatable drum for supporting a record film having a circumferential opening therein adapted to be bridged by the film and a photo-electric cell arranged within the drum, opposite said opening, the parts of the drum at opposite sides of said opening being fixedly connected with each other through the circumferential opening of

4. In apparatus for reproducing sound from a film record, a shaft, a film supporting drum mounted thereon comprising axially spaced complementary members, means for rotating the drum, a photo-electric cell, and means for supporting the cell in a fixed position within the drum and opposite the space between the members.

5. In apparatus for reproducing sound from a film record, a rotatable shaft, a film supporting drum mounted thereon comprising two axially spaced complementary portions one of said portions being movable along the shaft, a photo-electric cell within the drum and a support therefor extending through the space separating the two portions of the drum.

6. In apparatus for reproducing sound from a moving film having a sound record thereon, means comprising a drum for supporting the film, a photo-electric cell, and means for directing a light beam through the sound record into the photo-electric cell, the supporting means having an opening adapted to be bridged by the film and being constructed to support the film in a curved path at the point of intersection of the light beam therewith and at both sides of the sound record when passing said point, the portion of said supporting means at opposite sides of said opening being in fixed relation with each other.

7. In apparatus for reproducing sound from a moving film having a sound record thereon, an arcuate film supporting member curved in the direction of movement of the film and having portions in fixed relation with each other for engagement with the film on opposite sides of the sound record, a photo-electric cell, and means for directing a light beam through the sound record into said cell, said film supporting member having an opening therein to permit the free passage of the light beam therethrough.

8. In apparatus for reproducing sound from a moving film having a sound record thereon, a photo-electric cell, a source of light, means for directing a beam from said source through said record into said cell, and a member constructed and arranged to support the film in a longitudinally curved path at the point of intersection of the light beam therewith, said member having arcuate portions separated laterally by an open space for engaging the film at both sides of the sound record, and having means rigidly securing said portions together, the light beam being adapted to pass through the open space between said portions.

In witness whereof, I have hereunto set my hand this 1st day of July, 1927.

OSCAR STRINER

PLAINTIFFS' EXHIBIT NO. 36.

Copy of File Wrapper and Contents of Application for Above Steiner Patent (Marked for Identification, R. p. 1124).

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 37.

Sketch Made by Witness Tschopp (Defendants' Exhibit No. 49). (For Identification.)

(Shown at Page 701 of this Record.)

PLAINTIFFS' EXHIBIT NO. 38.

United States Patent No. 1,756,864.

370

April 29, 1930. C. A. HOXIE 1,756,864

FILM DRIVING APPARATUS

Filed April 19, 1929

Fig. 1.

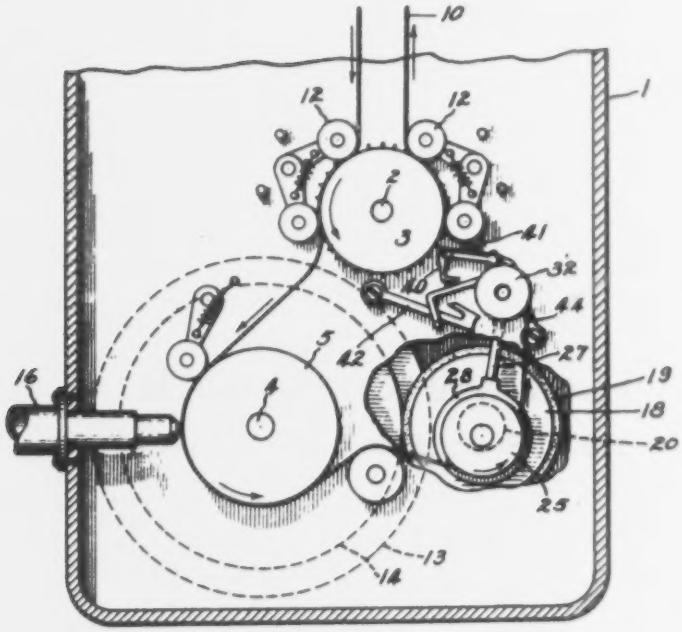


Fig. 3.

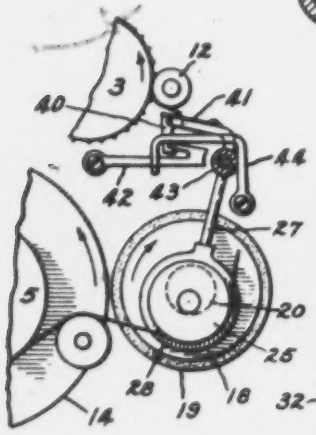


Fig. 2.

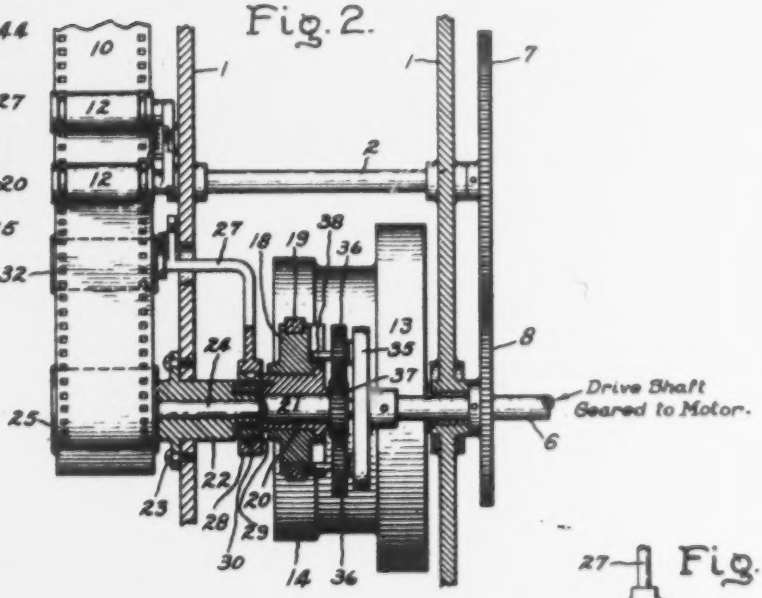


Fig. 4.

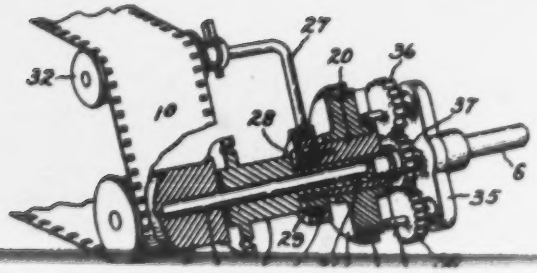
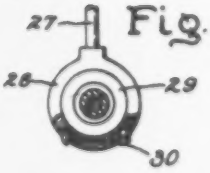


Fig. 5.



Inventor

Charles A Hoxie

Patented Apr. 29, 1930

1,756,864

UNITED STATES PATENT OFFICE

CHARLES A. HOXIE, OF ALPLAUS, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

FILM-DRIVING APPARATUS

Application filed April 19, 1929. Serial No. 356,536.

My invention relates to apparatus for making a sound record on a film of the motion picture type and to apparatus for reproducing the sound from a sound record on such a film; more particularly it relates to that part of the apparatus by means of which the film is driven.

The object of my invention is the provision of improved apparatus of this character which is of simple construction, inexpensive to manufacture and effective to move the film with the desired uniform speed.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 illustrates one embodiment of my invention; Fig. 2 is a cross sectional view of the same; and Figs. 3, 4 and 5 show details thereof.

In the drawing the casing 1 which supports the apparatus includes parallel walls in which are journalled the sprocket shaft 2 having the sprocket 3 on one end thereof and the drum shaft 4 having at one end thereof the drum 5. The sprocket 3 is adapted to be rotated at constant speed and is connected to the main driving shaft 6 by means of the gears 7 and 8. Sprocket 3 which is shown engaging the film 10 of the motion picture type at two spaced points thereof is, in the case of apparatus such as illustrated for making a film record of sound, adapted to perform the work of withdrawing the film from the take-off reel (not shown) and of feeding the film toward the take-up reel (also not shown). Between the two points of contact with the sprocket, the film extends over the drum 5 and apparatus to be described later for governing the speed of the drum. For holding the film in contact with the sprocket, I have shown two sets of pressure rolls 12 which can be readily thrown out of engagement with the sprocket when the operator threads the film. On the drum shaft 4 is mounted the flywheel 13 and the driven wheel 14; these two wheels being

tem by means of which a narrow band of light controlled by the sound waves being recorded is directed upon the film, the film at the point of exposure being supported by the smooth surface of the drum.

In the apparatus which I have devised the film is driven by both the sprocket and the drum. In apparatus of this character where the film is supported and moved by a drum at the point of exposure, and the same is true of reproducing apparatus in which the film is supported and moved by a drum at the point where the record is read off the film. it is essential for the faithful recording of the sound, or reproduction thereof in the case of a reproducer, that the drum rotate uniformly and that no slipping of the film occur on the drum. Since both the sprocket and the drum are positively driven from the same drive shaft 6, it is necessary to regulate their relative speeds for if no slipping of the film on the drum is to be permitted they will not in practice move the film at exactly the same rate. Even though the diameters and speeds of the sprocket and drum were theoretically correct for producing equal film speeds, shrinkage of the film in various amounts found in practice would, after a few hundred feet of film had been passed through the apparatus, result in a tightening of the film at one side of the drum and an accumulation of film at the other side thereof. In accordance with the apparatus which I shall now describe I cause the drum to be rotated at a speed which is governed by the rate at which the film is moved by the sprocket. Driving connection from the main drive shaft 6 to the driven wheel 14 is through the driving wheel 18 having the soft rubber periphery or tire 19 fixed thereto. Wheel 18 is rotatably mounted on the eccentric 20 which in turn is mounted on the sleeve extension 21 of the bearing member 22. This member is secured by screws 23 to a wall of the casing 1 and forms a bearing for a reduced extension 24 of the shaft 6. On the outer end of this shaft

FILM DRIVING APPARATUS

Filed April 19, 1929

Fig. 1.

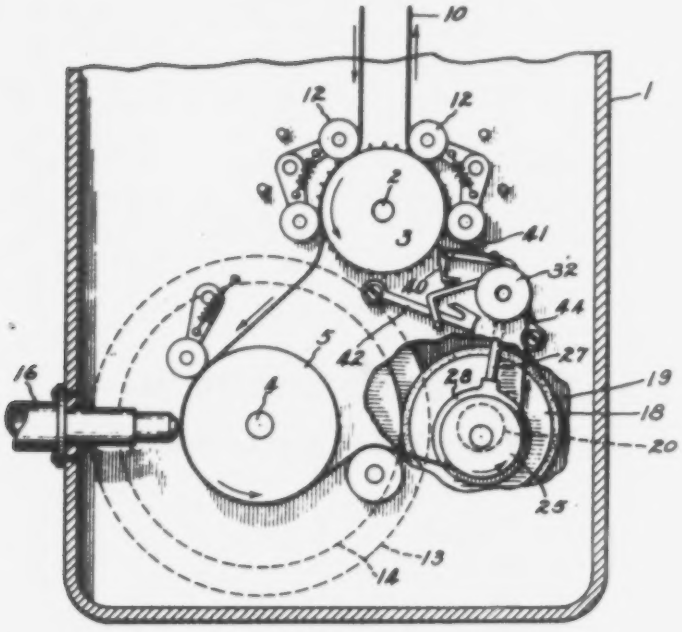


Fig. 3.

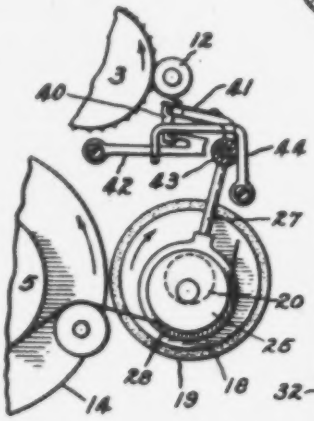


Fig. 2.

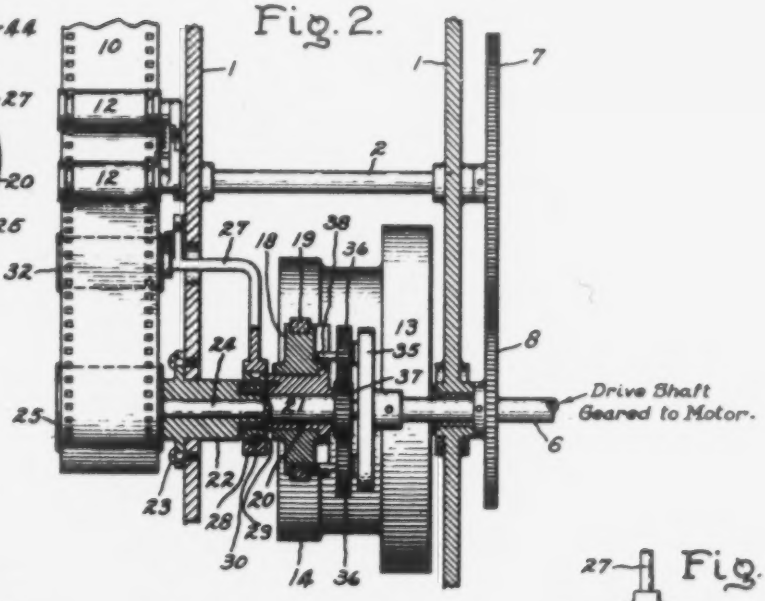


Fig. 4.

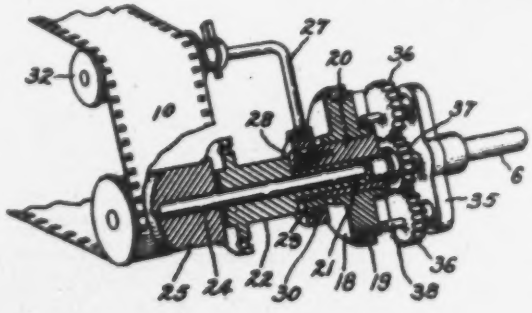
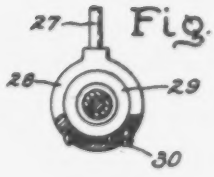


Fig. 5.



Inventor
Charles A. Hoxie
by Charles E. Tullar
His Attorney.

UNITED STATES PATENT OFFICE

CHARLES A. HOXIE, OF ALPLAUS, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

FILM-DRIVING APPARATUS

Application filed April 19, 1929. Serial No. 356,536.

My invention relates to apparatus for making a sound record on a film of the motion picture type and to apparatus for reproducing the sound from a sound record on such a film; more particularly it relates to that part of the apparatus by means of which the film is driven.

The object of my invention is the provision of improved apparatus of this character which is of simple construction, inexpensive to manufacture and effective to move the film with the desired uniform speed.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 illustrates one embodiment of my invention; Fig. 2 is a cross sectional view of the same; and Figs. 3, 4 and 5 show details thereof.

In the drawing the casing 1 which supports the apparatus includes parallel walls in which are journalled the sprocket shaft 2 having the sprocket 3 on one end thereof and the drum shaft 4 having at one end thereof the drum 5. The sprocket 3 is adapted to be rotated at constant speed and is connected to the main driving shaft 6 by means of the gears 7 and 8. Sprocket 3 which is shown engaging the film 10 of the motion picture type at two spaced points thereof is, in the case of apparatus such as illustrated for making a film record of sound, adapted to perform the work of withdrawing the film from the take-off reel (not shown) and of feeding the film toward the take-up reel (also not shown). Between the two points of contact with the sprocket, the film extends over the drum 5 and apparatus to be described later for governing the speed of the drum. For holding the film in contact with the sprocket, I have shown two sets of pressure rolls 12 which can be readily thrown out of engagement with the sprocket when the operator threads the film. On the drum shaft 4 is mounted the flywheel 13 and the driven wheel 14, these two wheels being shown on the drawing as parts of a single unit. In the wall of the casing 1 is mounted the tube 16 forming a part of the optical system by means of which a narrow band of light controlled by the sound waves being recorded is directed upon the film, the film at the point of exposure being supported by the smooth surface of the drum.

In the apparatus which I have devised the film is driven by both the sprocket and the drum. In apparatus of this character where the film is supported and moved by a drum at the point of exposure, and the same is true of reproducing apparatus in which the film is supported and moved by a drum at the point where the record is read off the film. it is essential for the faithful recording of the sound, or reproduction thereof in the case of a reproducer, that the drum rotate uniformly and that no slipping of the film occur on the drum. Since both the sprocket and the drum are positively driven from the same drive shaft 6, it is necessary to regulate their relative speeds for if no slipping of the film on the drum is to be permitted they will not in practice move the film at exactly the same rate. Even though the diameters and speeds of the sprocket and drum were theoretically correct for producing equal film speeds, shrinkage of the film in various amounts found in practice would, after a few hundred feet of film had been passed through the apparatus, result in a tightening of the film at one side of the drum and an accumulation of film at the other side thereof. In accordance with the apparatus which I shall now describe I cause the drum to be rotated at a speed which is governed by the rate at which the film is moved by the sprocket. Driving connection from the main drive shaft 6 to the driven wheel 14 is through the driving wheel 18 having the soft rubber periphery or tire 19 fixed thereto. Wheel 18 is rotatably mounted on the eccentric 20 which in turn is mounted on the sleeve extension 21 of the bearing member 22. This member is secured by screws 23 to a wall of the casing 1 and forms a bearing for a reduced extension 24 of the shaft 6. On the outer end of this shaft extension is the film engaging idler 25. By means of the arm 27 the eccentric 20 is angularly adjusted so as to cause the soft tire 19 on wheel 18 to press a variable amount

against the driven wheel 14. Arm 27 is fixed to ring 28 which ring is adjustably mounted on ring 29 fixed to the eccentric 20. Adjustment of the ring 28 on ring 29 is effected by the screw 30 which is supported by ring 28 and engages a threaded annular groove in ring 29. On its free end the arm 27 has the freely rotatable idler 32 which engages the film between idler 25 and sprocket 3.

Since the axis of drive wheel 18 is eccentric to the axis of rotation of drive shaft 6 and moves laterally with angular adjustments of the arm 27, an operative connection between shaft and the wheel must be provided whereby the angular velocity of the wheel at all parts of its rotation shall exactly equal the angular velocity of the drive shaft. The connection which I have shown for this purpose comprises the cross arm 35 secured to shaft 6 and having rotatably mounted thereon the two equal gear wheels 36. Meshing with these two gear wheels is the third gear wheel 37 having the same number of teeth and fixed to an extension on the eccentric. Each gear wheel 36 has a pin 38 extending from its face and arranged to slide in a radial groove in the adjacent face of wheel 18. The pins 38 are eccentrically mounted in the gears 36 the eccentricity being the same as that of the eccentric 20.

The above described construction operates in the following manner: Suppose the parts to be in the position shown by Fig. 1 wherein the driving wheel 18 is pressed against the driven wheel 14 an amount such as to cause a partial flattening of the soft rubber tire 19 at the point of contact. If with that degree of pressure the drum is being rotated at just the right speed to move the film as fast as it is moved by the sprocket, the contact arm 27 and idler 32 will remain in that position. If, however, the drum is rotating a little too slow, that part of the film extending over the idler 32 becomes more taut and thereby moves the arm 27 counterclockwise. This shifts the eccentric so as to cause the wheel 18 to press harder against the driven wheel 14 flattening down slightly more the soft rubber tire 19 at the point of contact. The resulting speed of the driven wheel and the drum contrary to what might be expected is increased. Conversely, if the drum speed is a little too fast, the arm 27 will move clockwise shifting the drive wheel 18 so as to decrease the pressure between it and the driven wheel whence the driven wheel and drum rotate more slowly. It is to be understood that no slipping whatever occurs between the driving and the driven wheels and that the above described speed variation between those wheels is purely a function of the pressure to which the soft rubber tire is subject from gearing, etc., in the connection to the driving motor. It forms a flexible driving member for the drum, directly associated with it and arranged between it and any and all gearing included in the drive connection.

The apparatus which I have devised is arranged to be driven by an electric motor, for example, a synchronous motor which through suitable reduction gearing connects with the shaft 6. Unless the motor is provided with some starting device, which is not usual with motors of the size employed to drive machines of this character, the motor when thrown on the line immediately starts off with a high torque quickly gaining full speed. Inasmuch as the film drum and flywheel are driven by a soft rubber tired wheel a certain amount of slipping between the tire and the driven wheel would occur each time the apparatus is started. I prefer to avoid this unnecessary wear of the rubber tire at starting and for this purpose have devised the apparatus which I shall now describe whereby the rubber tire does not contact with the driven wheel until the latter has reached approximately full speed. The arm 27 beyond the idler 32 is turned laterally and pivoted at the end thereof is the latch 40 being yieldingly held in the position illustrated by the leaf spring 41. The pivoted stop 42 has a projection which when the stop is raised engages the latch 40 so that the stop is retained in an elevated position. In this position, stop 42 engages portion 43 of the arm 27 supporting idler 32. Stop lifting lever 44 is arranged to be engaged by portion 43 and at its free end has a hook which receives the stop 42. These parts are so constructed and arranged that when a film is threaded in the machine and the idler 32 is moved to the right as viewed in Fig. 1 the stop 42 is raised by lever 44 and latched up in the raised position. The soft rubber tire is now out of contact with the driven wheel 14, see Fig. 3. The sudden start of the sprocket 3 when the motor is thrown on the circuit gives the film a jerk which shifts the arm 27 carrying idler 32 until it is stopped by the stop 42. During this movement the stop 42 is released but the movement of the arm 27 is so rapid that the stop is caught thereby before it has time to fall. Even in the new position of the arm 27 and idler 32 the rubber tire 19 does not engage the driven wheel. The film in passing over the drum quickly brings it and the flywheel up to speed, the tension in the film serving to hold portion 43 of the arm 27 firmly against stop 42. When the drum and flywheel reach full speed the film tension drops to a low value when the reaction of the wheel 18 on the eccentric withdraws the arm 27 from the stop 42, allowing the latter to

the drum and flywheel as has already been described.

While I have described my invention as forming a part of a sound recorder it is by no means limited to such apparatus but is equally applicable to apparatus for reproducing sound from a sound film record in which case the light beam passes through the film into a photo-electric cell in the well understood manner.

Inasmuch as the purpose of my invention is to drive the film past the light beam, the optical system may be arranged to direct the beam of light on the film at some point prior to the drum. For example, a gate or a skid may be provided between the drum and sprocket and the film exposed to the light beam as it passes through the gate or over the skid in which case the drum functions merely as a pulley for drawing the film at the proper uniform speed.

I have chosen the particular embodiment described above as illustrative of my invention and it will be apparent that various modifications may be made without departing from the spirit and scope of my invention, which modifications I aim to cover by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. Film driving apparatus comprising a plurality of driving members arranged to engage a film at spaced points, and means for varying the speed of one of said members in accordance with the length of film between the members, said means comprising a driven wheel connected with said one member, a driving wheel having a resilient face in non-slipping engagement with said driven wheel, a movable member arranged to engage the film between said members, and means responsive to movement of the movable member for varying the pressure of the driving wheel against the driven wheel.

2. Film driving apparatus comprising a sprocket member and a drum member arranged to engage a film respectively at points spaced longitudinally thereof, and means responsive to the length of film between said members for controlling the speed of one of the members, said means comprising a driven wheel connected with said one member, a driving wheel having a resilient face in non-slipping engagement with the driven wheel, and a member engaging the film between the sprocket and drum members for varying the pressure between said driving and driven members.

3. Film driving apparatus comprising a sprocket and a drum arranged to engage a film respectively at points spaced longitudinally thereof, a driven wheel connected with said drum, a driving wheel having a resilient face in non-slipping engagement with the driven wheel, and a member engaging the film between the sprocket and the drum for varying the pressure between the driving and the driven members.

4. Film driving apparatus comprising a sprocket and a drum arranged to engage a film respectively at points spaced longitudinally thereof, a motor having a fixed driving connection with one of said members and a variable driving connection with the other of said members, said variable driving connection comprising a driven wheel in fixed relation with said other member, a driving wheel having a resilient periphery in non-slipping engagement with said driven wheel and mounted to be moved bodily relative thereto to vary the pressure therewith and means controlled by the length of film between the sprocket and the drum for moving the driving wheel.

5. Film driving apparatus comprising a sprocket and a drum arranged to engage a film respectively at points spaced longitudinally thereof, a motor having a fixed driving connection with the sprocket and a variable driving connection with the drum, said variable driving connection comprising a driven wheel in fixed relation with said drum, a driving wheel having a soft rubber periphery in non-slipping engagement with the driven wheel, and means controlled by a loop in the film between the sprocket and the drum for moving the driving wheel toward or from the driven wheel to vary the pressure between said wheels.

6. Film driving apparatus comprising a sprocket and a drum, the film being arranged to engage the sprocket at two points spaced longitudinally thereof and to engage the drum at a third point intermediate said spaced points, the film forming a free loop between the drum and one point of contact with the sprocket, a common driving member for the sprocket and the drum and a variable speed connecting means between said driving member and said drum having a controlling member engaging the film between the drum and the other point of its contact with the sprocket.

7. Film driving apparatus comprising a sprocket and a drum, the film being arranged to engage the sprocket at two points spaced longitudinally thereof and to engage the drum at a third point intermediate said spaced points, the film forming a free loop between the drum and one point of contact with the sprocket, a common driving

on ring 29 fixed to the eccentric 20. Adjustment of the ring 28 on ring 29 is effected by the screw 30 which is supported by ring 28 and engages a threaded annular groove in ring 29. On its free end the arm 27 has the freely rotatable idler 32 which engages the film between idler 25 and sprocket 3.

Since the axis of drive wheel 18 is eccentric to the axis of rotation of drive shaft 6 and moves laterally with angular adjustments of the arm 27, an operative connection between shaft and the wheel must be provided whereby the angular velocity of the wheel at all parts of its rotation shall exactly equal the angular velocity of the drive shaft. The connection which I have shown for this purpose comprises the cross arm 35 secured to shaft 6 and having rotatably mounted thereon the two equal gear wheels 36. Meshing with these two gear wheels is the third gear wheel 37 having the same number of teeth and fixed to an extension on the eccentric. Each gear wheel 36 has a pin 38 extending from its face and arranged to slide in a radial groove in the adjacent face of wheel 18. The pins 38 are eccentrically mounted in the gears 36 the eccentricity being the same as that of the eccentric 20.

The above described construction operates in the following manner: Suppose the parts to be in the position shown by Fig. 1 wherein the driving wheel 18 is pressed against the driven wheel 14 an amount such as to cause a partial flattening of the soft rubber tire 19 at the point of contact. If with that degree of pressure the drum is being rotated at just the right speed to move the film as fast as it is moved by the sprocket, the contact arm 27 and idler 32 will remain in that position. If, however, the drum is rotating a little too slow, that part of the film extending over the idler 32 becomes more taut and thereby moves the arm 27 counterclockwise. This shifts the eccentric so as to cause the wheel 18 to press harder against the driven wheel 14 flattening down slightly more the soft rubber tire 19 at the point of contact. The resulting speed of the driven wheel and the drum contrary to what might be expected is increased. Conversely, if the drum speed is a little too fast, the arm 27 will move clockwise shifting the drive wheel 18 so as to decrease the pressure between it and the driven wheel whence the driven wheel and drum rotate more slowly. It is to be understood that no slipping whatever occurs between the driving and the driven wheels and that the above described speed variation between those wheels is purely a function of the pressure to which the soft rubber tire is subjected. In addition the soft rubber tire serves to damp out vibrations in the driving torque, such, for example, as those which may arise

member for the drum, directly associated with it and arranged between it and any and all gearing included in the drive connection.

The apparatus which I have devised is arranged to be driven by an electric motor, for example, a synchronous motor which through suitable reduction gearing connects with the shaft 6. Unless the motor is provided with some starting device, which is not usual with motors of the size employed to drive machines of this character, the motor when thrown on the line immediately starts off with a high torque quickly gaining full speed. Inasmuch as the film drum and flywheel are driven by a soft rubber tired wheel a certain amount of slipping between the tire and the driven wheel would occur each time the apparatus is started. I prefer to avoid this unnecessary wear of the rubber tire at starting and for this purpose have devised the apparatus which I shall now describe whereby the rubber tire does not contact with the driven wheel until the latter has reached approximately full speed. The arm 27 beyond the idler 32 is turned laterally and pivoted at the end thereof is the latch 40 being yieldingly held in the position illustrated by the leaf spring 41. The pivoted stop 42 has a projection which when the stop is raised engages the latch 40 so that the stop is retained in an elevated position. In this position, stop 42 engages portion 43 of the arm 27 supporting idler 32. Stop lifting lever 44 is arranged to be engaged by portion 43 and at its free end has a hook which receives the stop 42. These parts are so constructed and arranged that when a film is threaded in the machine and the idler 32 is moved to the right as viewed in Fig. 1 the stop 42 is raised by lever 44 and latched up in the raised position. The soft rubber tire is now out of contact with the driven wheel 14, see Fig. 3. The sudden start of the sprocket 3 when the motor is thrown on the circuit gives the film a jerk which shifts the arm 27 carrying idler 32 until it is stopped by the stop 42. During this movement the stop 42 is released but the movement of the arm 27 is so rapid that the stop is caught thereby before it has time to fall. Even in the new position of the arm 27 and idler 32 the rubber tire 19 does not engage the driven wheel. The film in passing over the drum quickly brings it and the flywheel up to speed, the tension in the film serving to hold portion 43 of the arm 27 firmly against stop 42. When the drum and flywheel reach full speed the film tension drops to a low value when the reaction of the wheel 18 on the eccentric withdraws the arm 27 from the stop 42, allowing the latter to drop to the position shown in Fig. 1. The rubber tired wheel 18 is now free to engage wheel 14 and to take up the work of driving

the drum and flywheel as has already been described.

While I have described my invention as forming a part of a sound recorder it is by no means limited to such apparatus but is equally applicable to apparatus for reproducing sound from a sound film record in which case the light beam passes through the film into a photo-electric cell in the well understood manner.

Inasmuch as the purpose of my invention is to drive the film past the light beam, the optical system may be arranged to direct the beam of light on the film at some point prior to the drum. For example, a gate or a skid may be provided between the drum and sprocket and the film exposed to the light beam as it passes through the gate or over the skid in which case the drum functions merely as a pulley for drawing the film at the proper uniform speed.

I have chosen the particular embodiment described above as illustrative of my invention and it will be apparent that various modifications may be made without departing from the spirit and scope of my invention, which modifications I aim to cover by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. Film driving apparatus comprising a plurality of driving members arranged to engage a film at spaced points, and means for varying the speed of one of said members in accordance with the length of film between the members, said means comprising a driven wheel connected with said one member, a driving wheel having a resilient face in non-slipping engagement with said driven wheel, a movable member arranged to engage the film between said members, and means responsive to movement of the movable member for varying the pressure of the driving wheel against the driven wheel.

2. Film driving apparatus comprising a sprocket member and a drum member arranged to engage a film respectively at points spaced longitudinally thereof, and means responsive to the length of film between said members for controlling the speed of one of the members, said means comprising a driven wheel connected with said one member, a driving wheel having a resilient face in non-slipping engagement with the driven wheel, and a member engaging the film between the sprocket and drum members for varying the pressure between said driving and driven members.

3. Film driving apparatus comprising a sprocket and a drum arranged to engage a film respectively at points spaced longitudinally thereof, and means responsive to the length of film between the sprocket and the drum for controlling the speed of the drum, said means comprising a driven wheel connected with said drum, a driving wheel having a resilient face in non-slipping engagement with the driven wheel, and a member engaging the film between the sprocket and the drum for varying the pressure between the driving and the driven members.

4. Film driving apparatus comprising a sprocket and a drum arranged to engage a film respectively at points spaced longitudinally thereof, a motor having a fixed driving connection with one of said members and a variable driving connection with the other of said members, said variable driving connection comprising a driven wheel in fixed relation with said other member, a driving wheel having a resilient periphery in non-slipping engagement with said driven wheel and mounted to be moved bodily relative thereto to vary the pressure therewith and means controlled by the length of film between the sprocket and the drum for moving the driving wheel.

5. Film driving apparatus comprising a sprocket and a drum arranged to engage a film respectively at points spaced longitudinally thereof. a motor having a fixed driving connection with the sprocket and a variable driving connection with the drum, said variable driving connection comprising a driven wheel in fixed relation with said drum, a driving wheel having a soft rubber periphery in non-slipping engagement with the driven wheel, and means controlled by a loop in the film between the sprocket and the drum for moving the driving wheel toward or from the driven wheel to vary the pressure between said wheels.

6. Film driving apparatus comprising a sprocket and a drum, the film being arranged to engage the sprocket at two points spaced longitudinally thereof and to engage the drum at a third point intermediate said spaced points, the film forming a free loop between the drum and one point of contact with the sprocket, a common driving member for the sprocket and the drum and a variable speed connecting means between said driving member and said drum having a controlling member engaging the film between the drum and the other point of its contact with the sprocket.

7. Film driving apparatus comprising a sprocket and a drum, the film being arranged to engage the sprocket at two points spaced longitudinally thereof and to engage the drum at a third point intermediate said spaced points, the film forming a free loop between the drum and one point of contact with the sprocket, a common driving member for the sprocket and the drum having a fixed driving connection with the sprocket and a variable driving connection with the drum, said variable connection comprising a driven wheel connected with the drum, a driving wheel therefor connected with the com-

mon driven member and having a soft rubber tire and means including a controlling idler engaging the film between the drum and the other point of its contact with the sprocket for varying the pressure between the driving and driven wheels thereby varying the relative speeds of said wheels without slippage.

8. Film driving apparatus comprising a pair of film driving members arranged to engage a film at spaced points thereof, a driven wheel connected to one of said members, an eccentric, a driving wheel having a resilient face mounted in said eccentric and arranged to be moved bodily relative to the driven wheel to vary the pressure therewith without slippage in accordance with length of film between said members, a drive shaft having fixed bearings, and a driving connection between said shaft and said driving wheel.

9. Film driving apparatus comprising a sprocket and a drum arranged to engage a film at spaced points thereof, a driven wheel connected with the drum, an eccentric having an arm in engagement with the film between the sprocket and the drum, a driving wheel having a resilient face mounted on said eccentric whereby angular movement of the eccentric varies the contact pressure without slippage between the driving and the driven wheels, a drive shaft in alinement with the axis of rotation of the eccentric, and a driving connection between the drive shaft and the driving wheel comprising a gear fixed to the eccentric, and cooperating planetary gears mounted on the shaft each having an eccentric pin engaging in a radial slot in the driving wheel, the eccentricity of the pins and the eccentric being equal.

10. Film driving apparatus comprising a rotatable drum adapted to engage and move a film at a uniform speed, a flywheel and driven wheel directly connected with said drum, a motor driven shaft subject to gear vibrations, and a wheel driven by said shaft having a soft rubber tire in driving engagement with said driven wheel.

In witness whereof, I have hereto set my hand this 18th day of April, 1929.

CHARLES A. HOXIE.

PLAINTIFFS' EXHIBIT NO. 39.

Certified Copy of File Wrapper and Contents, Hoxie Patent No. 1,758,794.. (Marked for Identification, R. p. 1279.)

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 40.

United States Patent No. 1,258,298.

S. BARDY.

MOTION PICTURE APPARATUS FOR PROJECTORS AND CAMERAS.

APPLICATION FILED APR. 3, 1916.

1,258,298.

Patented Mar. 5, 1918.

5 SHEETS—SHEET 1.

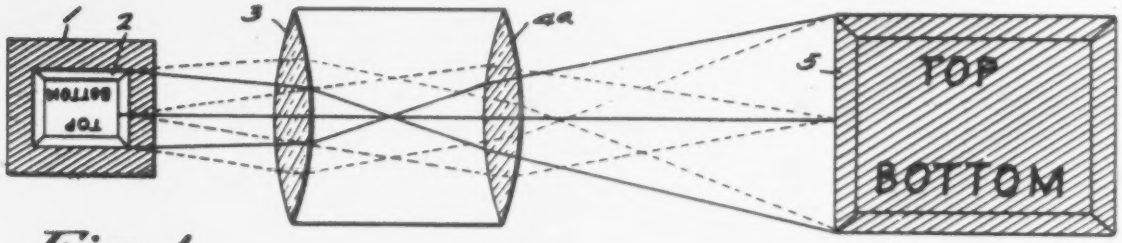


Fig. 1.

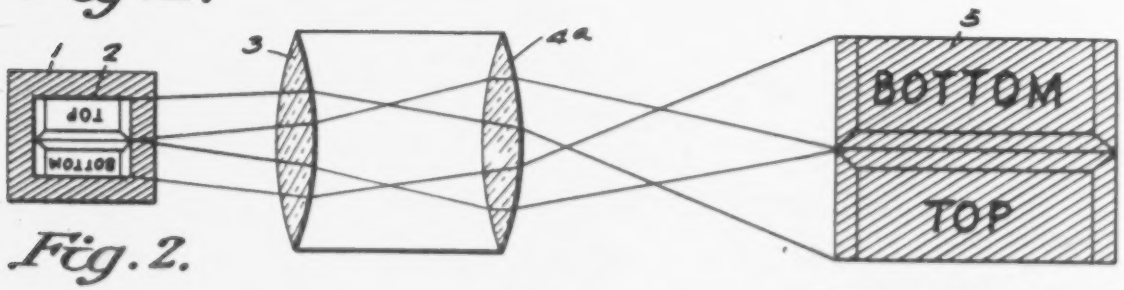


Fig. 2.

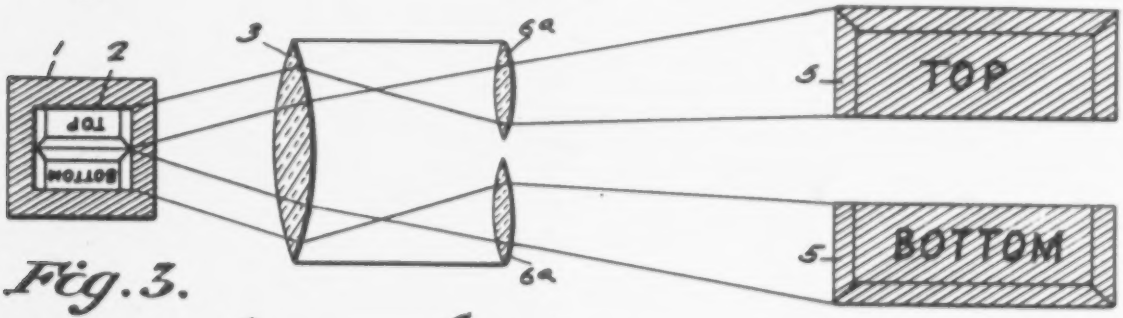


Fig. 3.

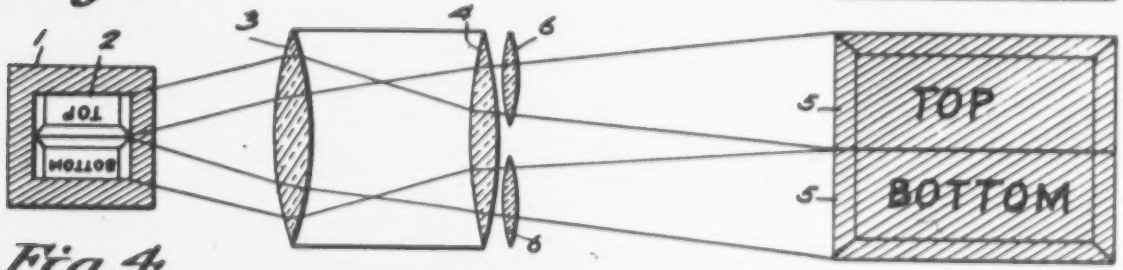


Fig. 4.

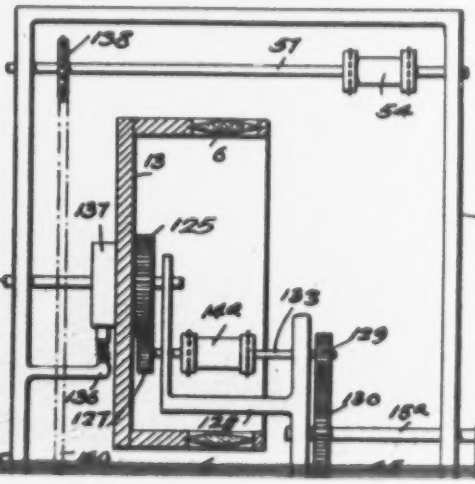


Fig. 20.

Witnesses:

Allen Latchaw

Inventor:

1,258,298.

APPLICATION FILED APR. 3, 1916.

Patented Mar. 5, 1918.

5 SHEETS—SHEET 1.

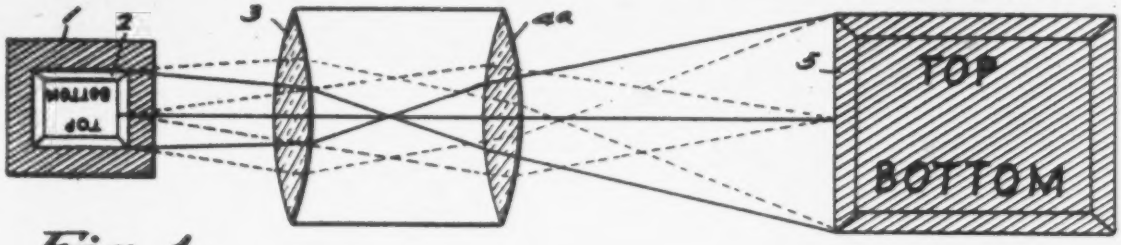


Fig. 1.

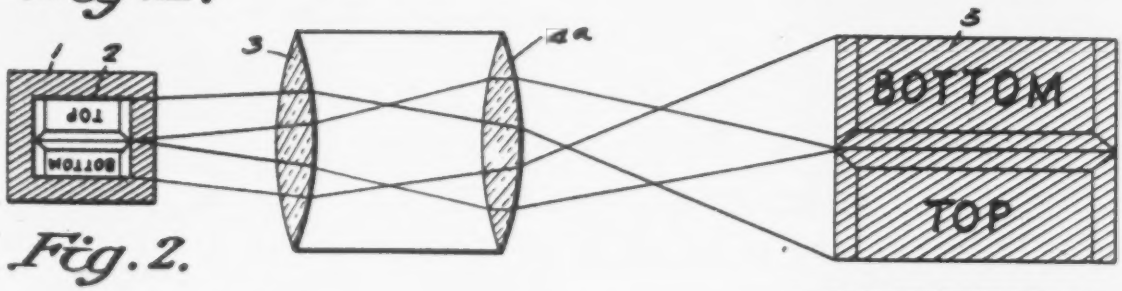


Fig. 2.

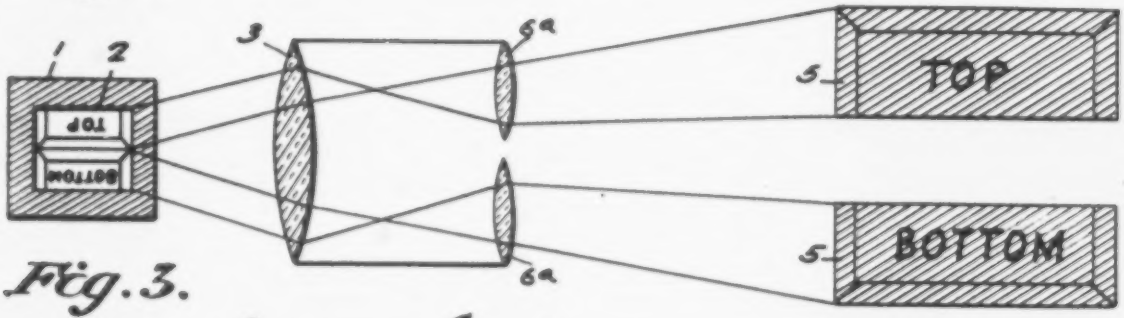


Fig. 3.

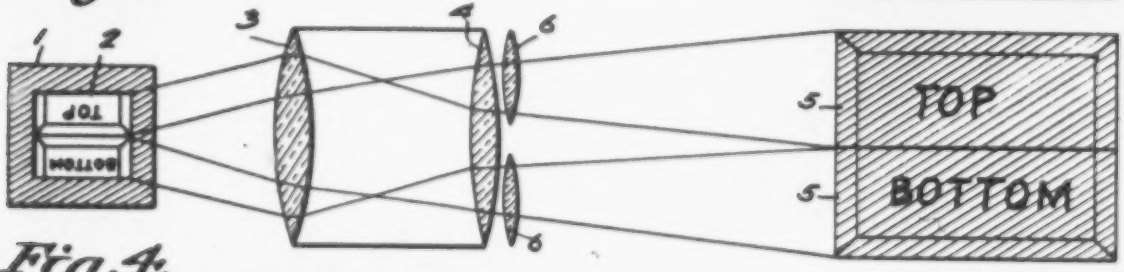


Fig. 4.

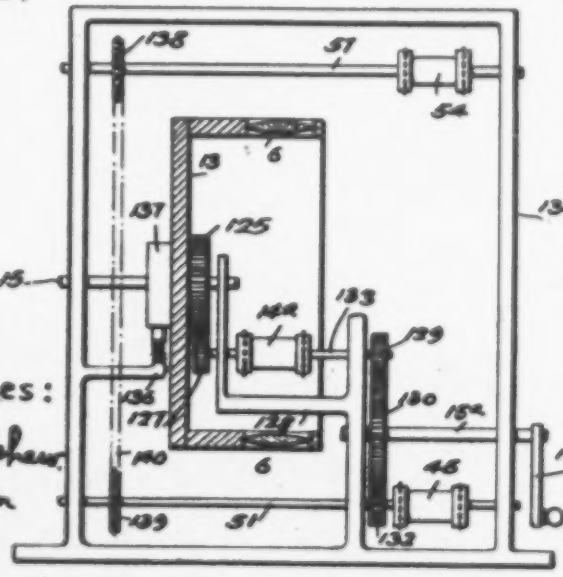


Fig. 20.

Witnesses:
Allen Batchelor
E. N. Hagen

Inventor:
Samuel Bardy
per Allen B. Clement
Attorney.

380

S. BARDY.

MOTION PICTURE APPARATUS FOR PROJECTORS AND CAMERAS.

APPLICATION FILED APR. 3, 1916.

1,258,298.

Patented Mar. 5, 1918.

5 SHEETS—SHEET 2.

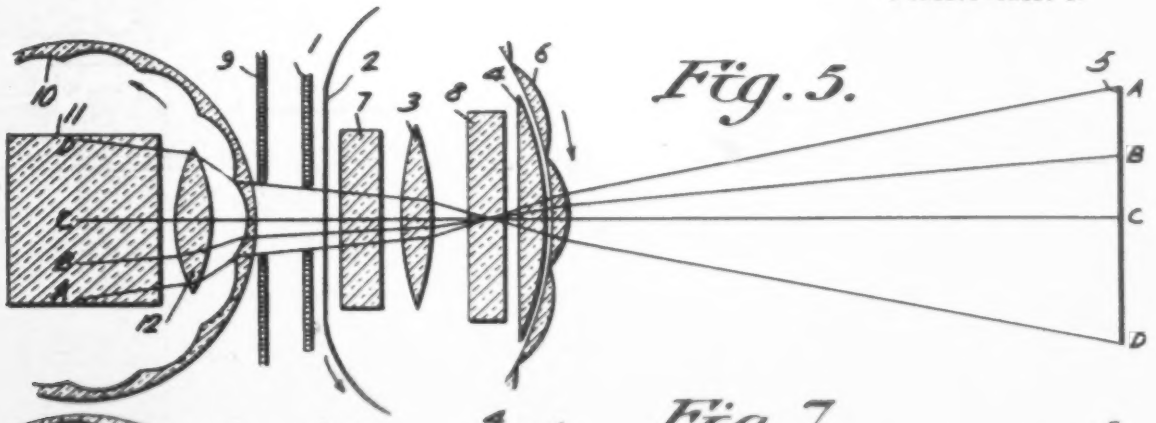


Fig. 5.

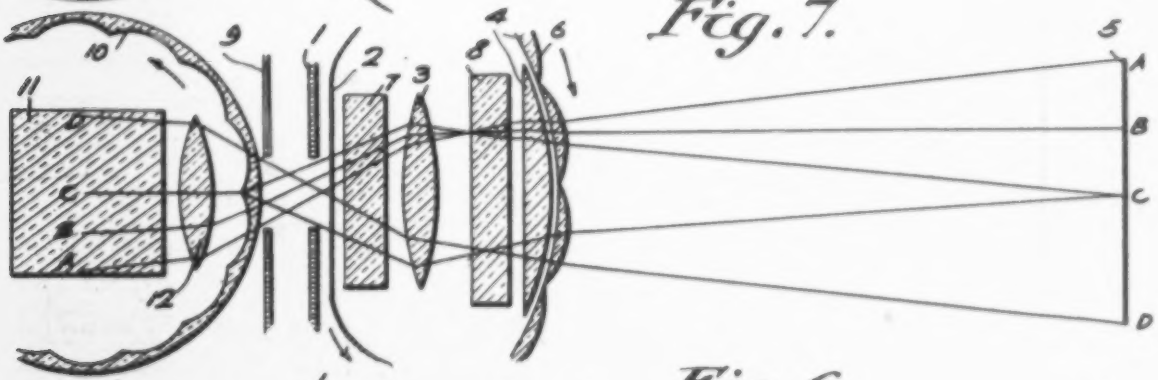


Fig. 7.

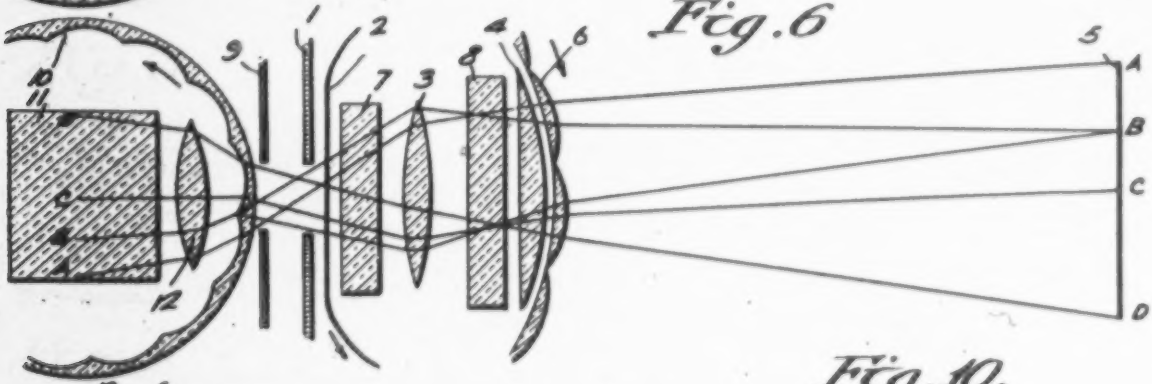


Fig. 6

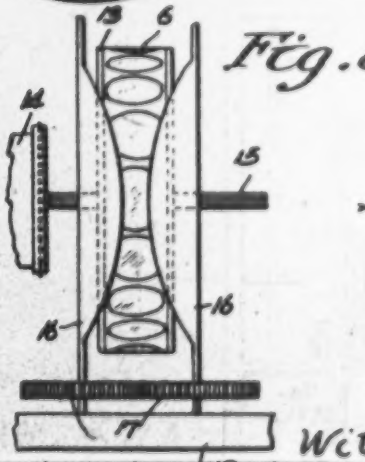
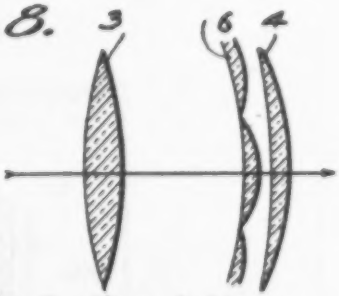


Fig. 8.



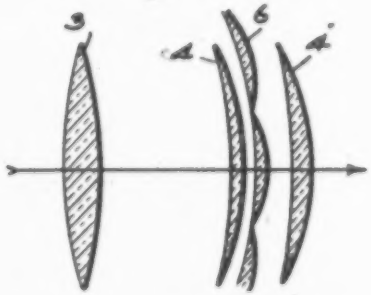


Fig. 10.

Fig. 9.

Witnesses:

Inventor:
Samuel Bardy

MOTION PICTURE APPARATUS FOR PROJECTORS AND CAMERAS.

APPLICATION FILED APR. 3, 1916.

1,258,298.

Patented Mar. 5, 1918.

3 SHEETS—SHEET 2.

Fig. 5.

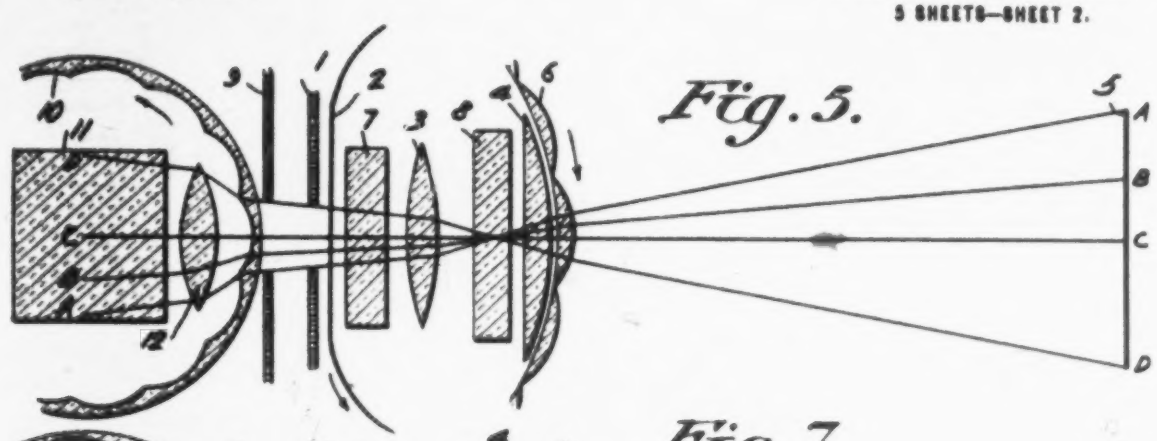


Fig. 7.

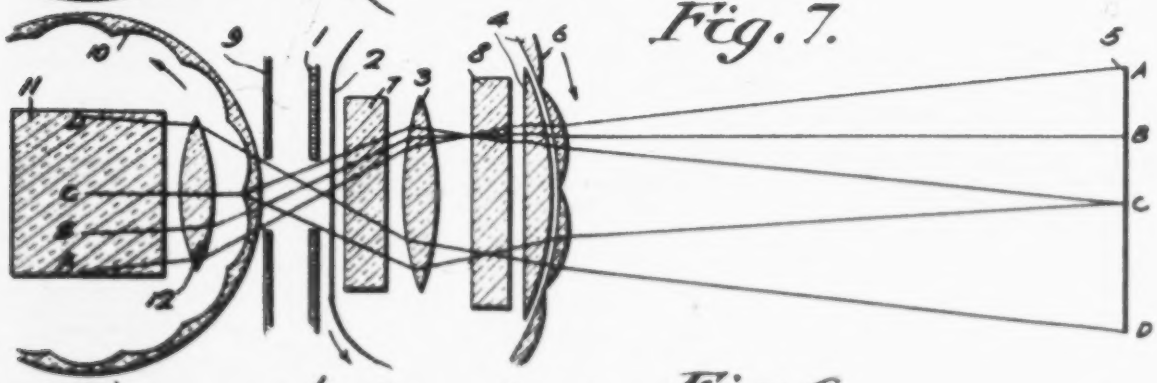


Fig. 6

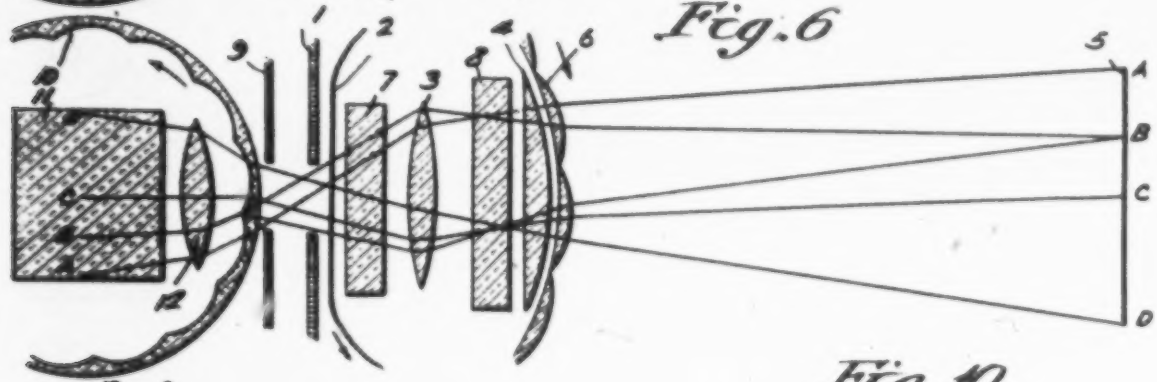


Fig. 10.

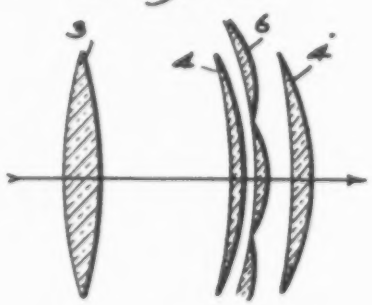
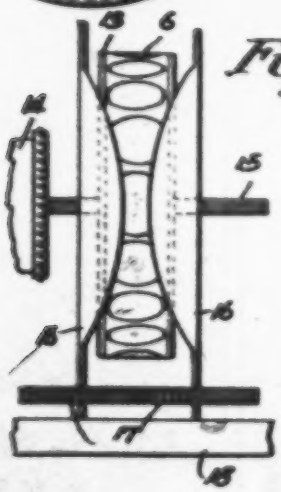


Fig. 8.



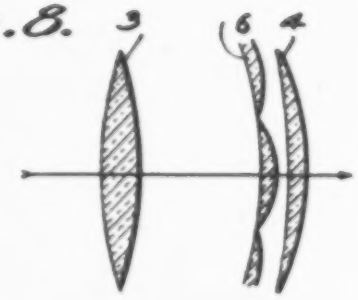


Fig. 9.

Witnesses:
Allen Latshaw.
B. K. Hagen

Inventor:
Samuel Bardy
Per Allen B. Coleman
Attorney.

382

S. BARDY.

MOTION PICTURE APPARATUS FOR PROJECTORS AND CAMERAS.

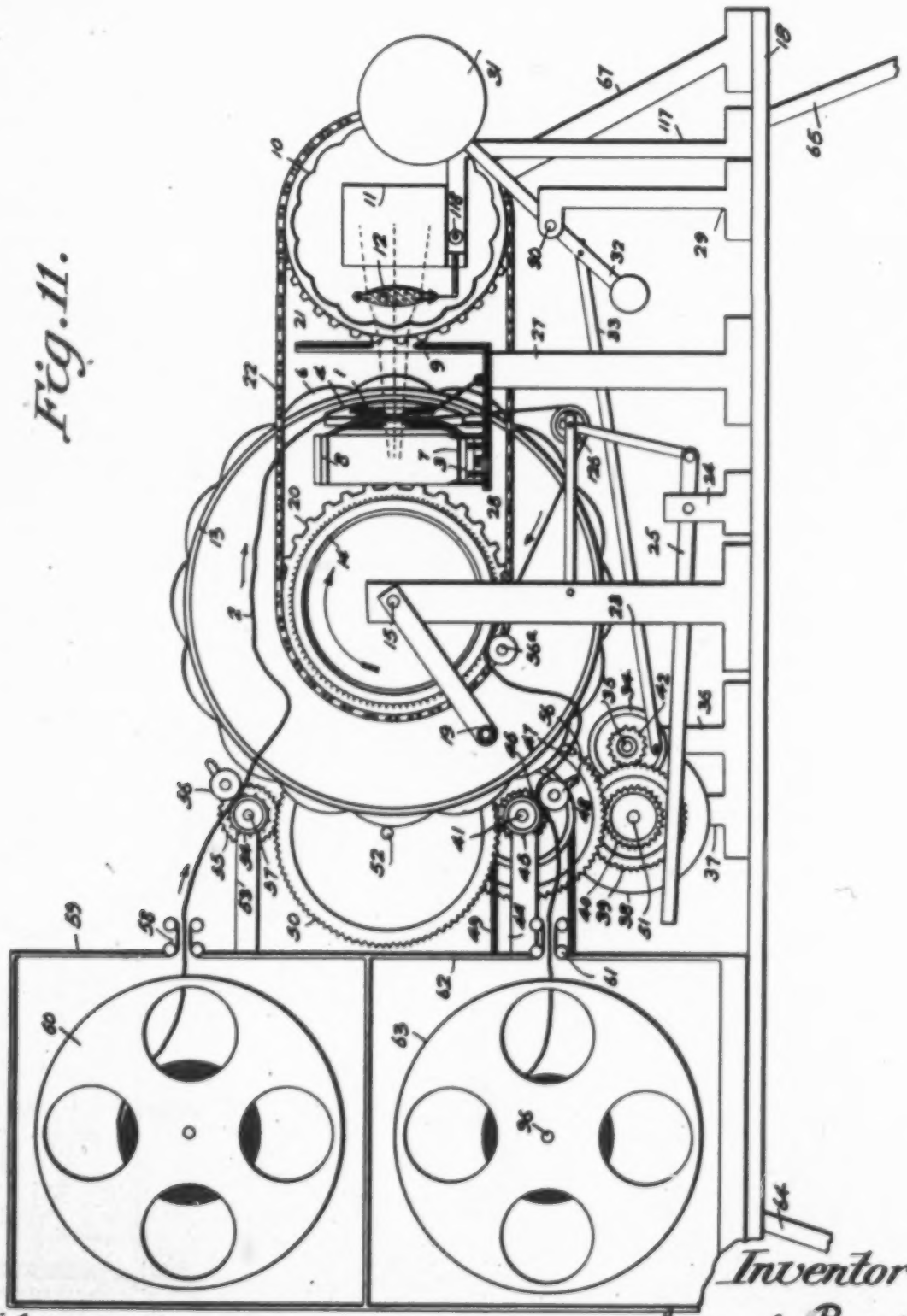
APPLICATION FILED APR. 3, 1916.

1,258,298.

Patented Mar. 5, 1918.

5 SHEETS—SHEET 3.

Fig. 11.



Witnesses:

Inventor:
Samuel Bardy

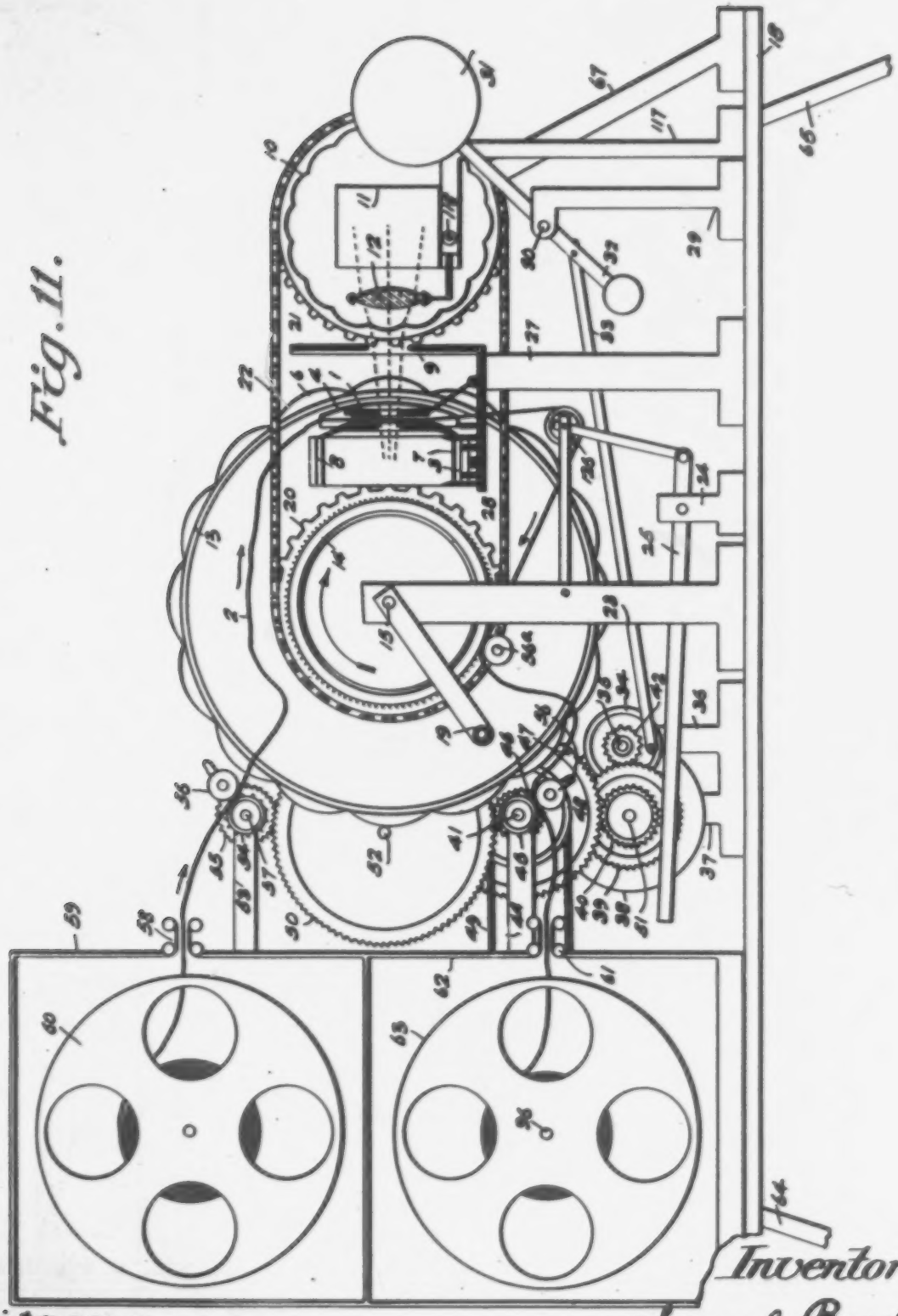
APPLICATION FILED APR. 3, 1916.

1,258,298.

Patented Mar. 5, 1918.

5 SHEETS—SHEET 3.

Fig. 11.



Witnesses:
Allen Latchaw.
B. H. Hagen

Inventor:
Samuel Bardy
Per Allen B. Clement
Attorney.

384

S. BARDY.

MOTION PICTURE APPARATUS FOR PROJECTORS AND CAMERAS.

APPLICATION FILED APR. 3, 1916.

1,258,298.

Patented Mar. 5, 1918.

5 SHEETS—SHEET 4.

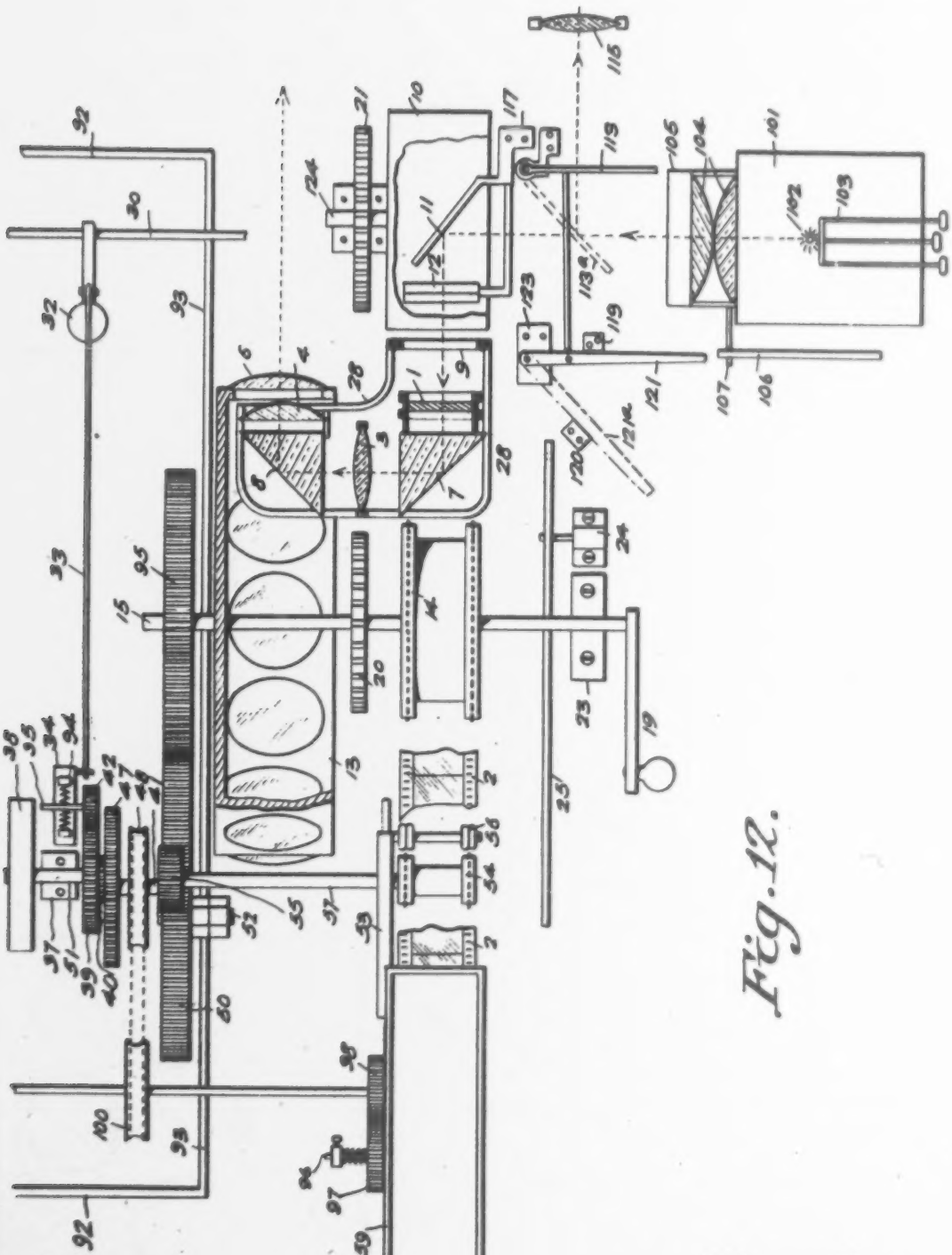


Fig. 12.

Witnesses:

Inventor:
Samuel Bardy

1,258,298.

APPLICATION FILED APR. 3, 1916.

Patented Mar. 5, 1918.

3 SHEETS—SHEET 4.

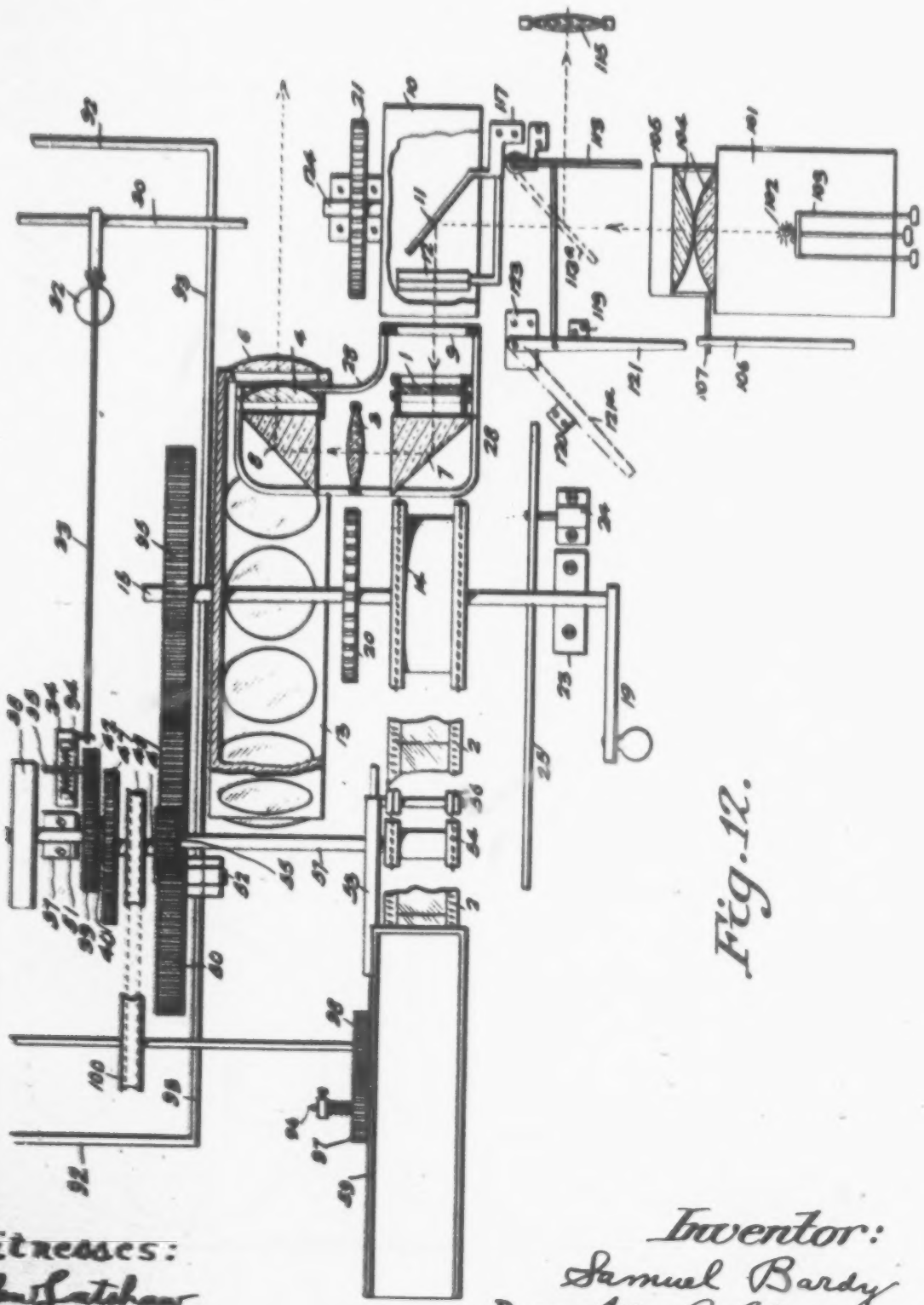


Fig. 12.

Witnesses:
Allen Latcham
L. K. Hagen

Inventor:
Samuel Bardy
Per Allen B. Clement
Attorney.

386

S. BARDY.

MOTION PICTURE APPARATUS FOR PROJECTORS AND CAMERAS.

APPLICATION FILED APR. 3, 1916.

1,258,298.

Patented Mar. 5, 1918.

5 SHEETS—SHEET 5.

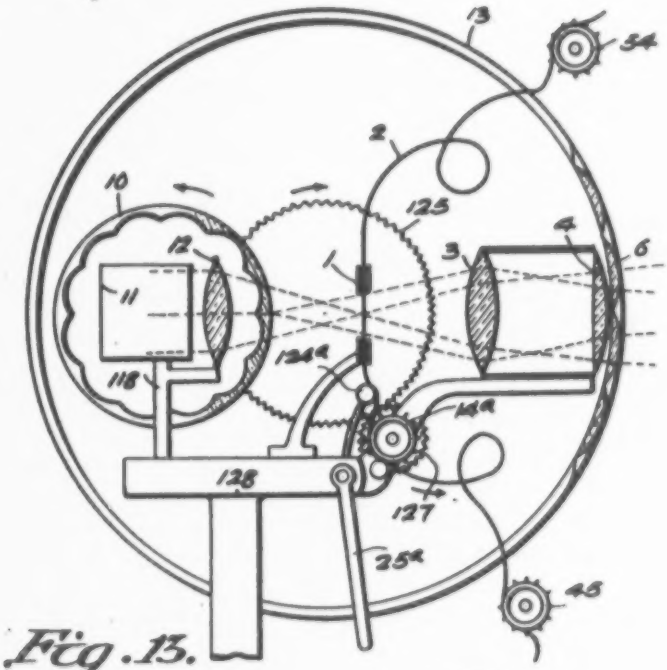


Fig. 13.

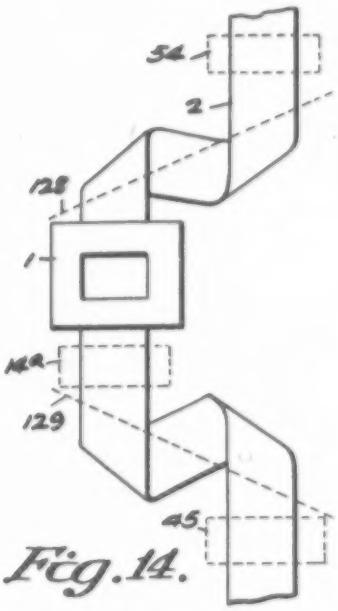


Fig. 14.

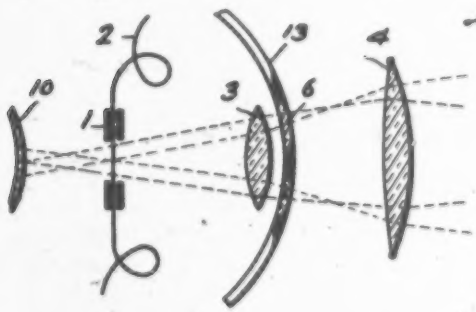


Fig. 16.

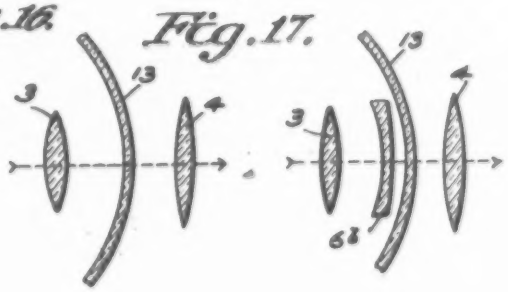


Fig. 17.

Fig. 15.

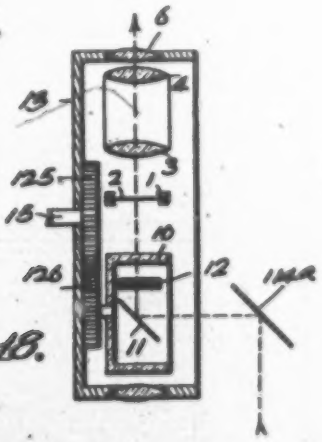


Fig. 18.

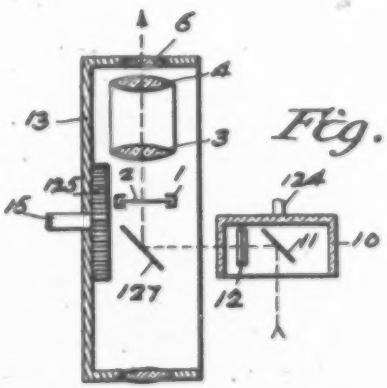


Fig. 19.

Witnesses:

Inventor:

UNITED STATES PATENT OFFICE.

SAMUEL BARDY, OF PHILADELPHIA, PENNSYLVANIA.

MOTION-PICTURE APPARATUS FOR PROJECTORS AND CAMERAS.

1,258,298. Specification of Letters Patent. Patented Mar. 5, 1918.

Application filed April 3, 1916. Serial No. 88,591.

To all whom it may concern:

Be it known that I, SAMUEL BARDY, a citizen of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented certain new and useful Improvements in Motion-Picture Apparatus for Projectors and Cameras, of which the following is a specification, reference being made to the accompanying drawings.

The objects of my invention are:—

First:—To provide a machine eliminating the shutter and intermittent movement in projectors and cameras for the production and use of moving pictures.

Second:—To move the film continuously when the instrument is in operation.

Third:—To overcome momentum and increase the life of the film.

Fourth:—To secure a series of stationary illuminations upon the moving film in a camera.

Fifth:—To secure upon a screen a series of stationary uniform illuminations through a continuously moving film.

Sixth:—To secure a blending of one unit image into another without interruption, flash or blur thereby securing natural production of motion upon the screen far superior to anything now in use.

Seventh:—By introducing conditions which permit of the use of lenses of much larger dimensions for the rotating series of lenses than the size of the picture or the aperture resulting in much more intense illumination and effective projection.

Eighth:—To secure a continuous uniform speed of the film, synchronously with the rotating lenses, during operation and eliminating wear and tear on the film and thereby increasing its life.

I am aware that patents have been issued having optically compensated continuously moved films but prior to my improvement no such devices have been free from mechanism admitting of "play" or "give and take" thereby preventing a high degree of synchronism between the mechanical and optical parts resulting in a vibration and which the light is subdivided into beams prior to passing through the film in such a way that the respective parts of illumination remain constant in intensity and stationary upon the screen without regard to the motions of the various parts of my device and the running of the film, as hereinafter shown and illustrated.

Other objects and advantages of my apparatus will be apparent upon examining my specifications.

I attain these objects by the mechanism shown in the accompanying drawings given for illustrative purposes but not to limit my invention and in which similar numbers refer to similar parts throughout the respective drawings.

Figures 1—2—3 and 4 are for showing the elements and development of my device and the optical principles of the machine.

Figs. 5—6 and 7 show diagrammatically in one plane the arrangement of optical elements and their effects.

Fig. 8 is a front view of the revolving series of lenses (6) which are fixed upon a cylindrical drum (13) revolving upon a common axle (15) to which both the lens drum and the sprocket, which operates the film, are rigidly fixed thereby securing perfect synchronism. (16) are adjustable shutter blades to equalize and control the light.

Fig. 9, shows lens (4) on the out side of revolving lens series (6) rather than on the inside as shown in the previous figure. The result is same in either case.

Fig. 10 shows a division of lens (4) into two lenses of weaker strength which are respectively (4^b), situated behind lens series (6), and (4^a), situated in front of said lens series (6). The result in this case is same as when single lens (4) is used.

Fig. 11 is the operator's side view with the lamp house omitted.

Fig. 12 shows top plan with parts omitted which would otherwise obscure view of certain essential parts.

Fig. 13 is an application of my device omitting the reflectors 7 and 8.

Fig. 14 illustrates the looping of the film

MOTION PICTURE APPARATUS FOR PROJECTORS AND CAMERAS.

APPLICATION FILED APR. 3, 1916.

1,258,298.

Patented Mar. 5, 1918.

5 SHEETS—SHEET 5.

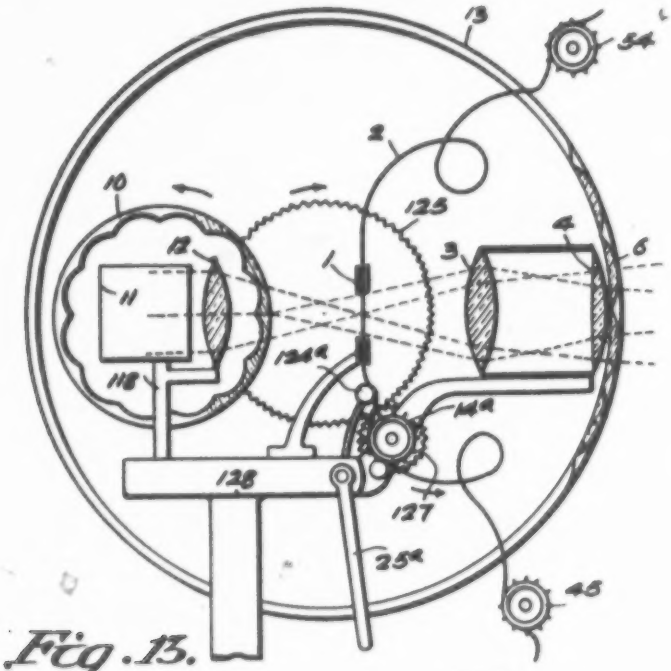


Fig. 13.

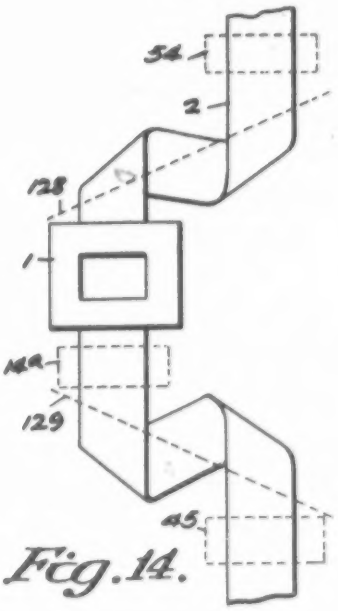


Fig. 14.

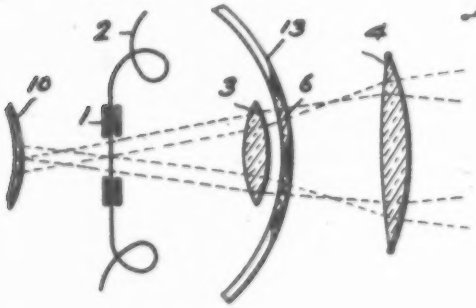


Fig. 16.

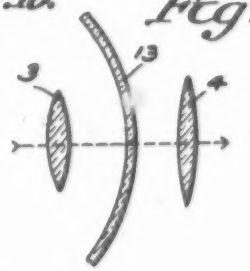


Fig. 17.

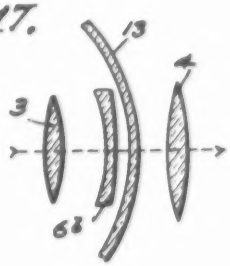


Fig. 15.

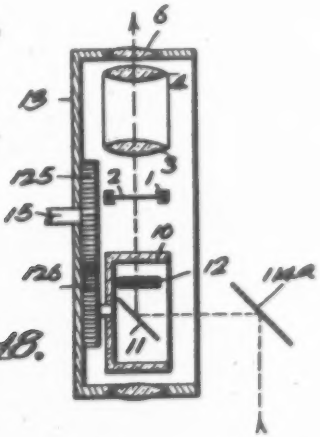


Fig. 18.

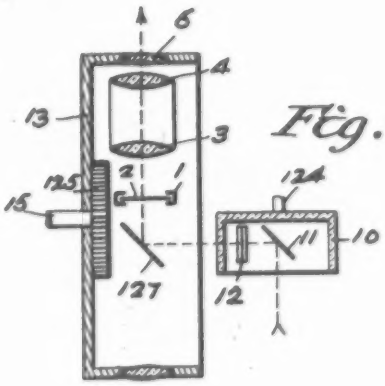


Fig. 19.

Witnesses:
Allen Satchaw.
E. H. Kagen

Inventor:
Samuel Bardy
Per Allen B. Clement
Attorney.

SAMUEL BARDY, OF PHILADELPHIA, PENNSYLVANIA.

MOTION-PICTURE APPARATUS FOR PROJECTORS AND CAMERAS.

1,258,298. Specification of Letters Patent. Patented Mar. 5, 1918.

Application filed April 3, 1916. Serial No. 88,591.

To all whom it may concern:

Be it known that I, SAMUEL BARDY, a citizen of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented certain new and useful Improvements in Motion-Picture Apparatus for Projectors and Cameras, of which the following is a specification, reference being made to the accompanying drawings.

The objects of my invention are:—

First:—To provide a machine eliminating the shutter and intermittent movement in projectors and cameras for the production and use of moving pictures.

Second:—To move the film continuously when the instrument is in operation.

Third:—To overcome momentum and increase the life of the film.

Fourth:—To secure a series of stationary illuminations upon the moving film in a camera.

Fifth:—To secure upon a screen a series of stationary uniform illuminations through a continuously moving film.

Sixth:—To secure a blending of one unit image into another without interruption, flash or blur thereby securing natural production of motion upon the screen far superior to anything now in use.

Seventh:—By introducing conditions which permit of the use of lenses of much larger dimensions for the rotating series of lenses than the size of the picture or the aperture resulting in much more intense illumination and effective projection.

Eighth:—To secure a continuous uniform speed of the film, synchronously with the rotating lenses, during operation and eliminating wear and tear on the film and thereby increasing its life.

I am aware that patents have been issued having optically compensated continuously moved films but prior to my improvement no such devices have been free from mechanism admitting of "play" or "give and take" thereby preventing a high degree of synchronism between the mechanical and optical parts resulting in a vibration and blur of the secured image constantly increased with the wear of the mechanism and producing a strain upon the eye more trying than the flicker of the present shutter projector.

Neither am I aware of any method by which the light is subdivided into beams prior to passing through the film in such a way that the respective parts of illumination remain constant in intensity and stationary upon the screen without regard to the motions of the various parts of my device and the running of the film, as hereinafter shown and illustrated.

Other objects and advantages of my apparatus will be apparent upon examining my specifications.

I attain these objects by the mechanism shown in the accompanying drawings given for illustrative purposes but not to limit my invention and in which similar numbers refer to similar parts throughout the respective drawings.

Figures 1—2—3 and 4 are for showing the elements and development of my device and the optical principles of the machine.

Figs. 5—6 and 7 show diagrammatically in one plane the arrangement of optical elements and their effects.

Fig. 8 is a front view of the revolving series of lenses (6) which are fixed upon a cylindrical drum (13) revolving upon a common axle (15) to which both the lens drum and the sprocket, which operates the film, are rigidly fixed thereby securing perfect synchronism. (16) are adjustable shutter blades to equalize and control the light.

Fig. 9, shows lens (4) on the out side of revolving lens series (6) rather than on the inside as shown in the previous figure. The result is same in either case.

Fig. 10 shows a division of lens (4) into two lenses of weaker strength which are respectively (4^b), situated behind lens series (6), and (4^a), situated in front of said lens series (6). The result in this case is same as when single lens (4) is used.

Fig. 11 is the operator's side view with the lamp house omitted.

Fig. 12 shows top plan with parts omitted which would otherwise obscure view of certain essential parts.

Fig. 13 is an application of my device omitting the reflectors 7 and 8.

Fig. 14 illustrates the looping of the film as a mechanical substitution in the use of my device without reflectors.

Figs. 15—16 and 17 show variations in position and modification of the movable series of lenses (6.)

Fig. 18 illustrates the top view of Fig. 13.

Fig. 19 shows variation of the position of the optically dividing scheme behind the film.

Fig. 20 shows the mechanical operation of Fig. 13 for clearness omitting certain parts.

The explanation of the optical principle of my machine is as follows:—

In Fig. 1 I have halves of two picture areas on film (2) in the aperture plate (1) and projection lens of the conventional type (3) and (4^a) which project image on screen (5). The passage of the rays of light through the film and lenses, as they are ordinarily projected according to the standard system of projection lenses, naturally forms the image of the halves of the two pictures on the screen.

In Fig. 2 I divide the illumination before it passes through the aperture (1) and film (2) by a method shown in Fig. 7, so that the illumination of the top segment of picture area of film (2) is brought up to be refracted by the top part of lens (3) in such manner that the rays will be refracted by the top part of lens (4^a).

And in like manner the illumination of the bottom segment of picture area of film (2) is brought down to be refracted by the lower part of lens (3) in such manner that the rays will be refracted by the bottom part of lens (4^a). The resulting image on the screen will be the same in either case whether projected as in Fig. 1 or as in Fig. 2 according to the well known principle of lenses.

It will be observed that the previously divided rays of light from the upper segment of picture area on film in Fig. 1 are brought to the lower part of lens (4^a) while in Fig. 2 said rays, having been divided by my scheme, shown in Fig. 7, are brought to the top part of lens (4^a) and the lower segment of picture area on film in Fig. 1 is brought to the upper part of lens (4^a) while in Fig. 2 said rays are brought to the bottom part of lens (4^a). Another difference noted is that in case of Fig. 1 the rays from upper and lower segments are always in close proximity, while in Fig. 2 the rays from the upper and lower segments are widely separated so that the rays from each respective segment will pass properly through their respective lenses of the movable series (6) which will be explained later in more detail.

In Fig. 1 and Fig. 2 the image on screen (5) consists of halves of two pictures since halves of two picture segments are in the aperture (1). By examining Fig. 2 I notice that the rays after passing lens (4^a) are crossed in order to reach their respective segment of image on screen. My invention by the segments of the image on the screen as shown in Fig. 4, and thereby form an independent picture on the screen from segments of two pictures.

Fig. 3 shows the evolution of my optical scheme in which I substitute two lenses (6^a) for lens (4^a) of Fig. 2 and each unit lens (6^a) being the same strength as lens (4^a). The rays which would otherwise be crossed *en route* to the screen become widely divergent, and I have segments in such relation to each that only a gap between prevents that would otherwise form a complete picture.

Fig. 4 shows the method of juxtaposing the two segments on screen by combining the effect of lens (4^a) of Fig. 2 with the two lenses (6^a) of Fig. 3 in such proportions as to eliminate the gap between the segments on screen in Fig. 3. The lenses (4) and (6) Fig. 4 have a combined strength equal to (6^a) Fig. 3, and the focal length of the combined lenses of Fig. 4 is equal to (4^a) of Fig. 1.

In series of lenses like (6) of Fig. 4 moving synchronously and in the same general direction with the moving film, with a separate lens (6) taking care of each segment of picture areas of the film aperture, by being opposite the film aperture when there is a complete picture in front of aperture, compensating for the motion of the film, secures a complete picture on screen at all times thus eliminating the use of the shutter, of the ordinary machine, which causes the flicker.

Merely having a series of moving lenses to compensate for the film motion, cannot answer the purpose, however, unless the movable series of lenses (6) move steadily without vibration and in a continuous motion, absolutely synchronously with the moving film, and in order to attain these results, I make use of certain optical and mechanical parts and combinations now described, as well as the method of dividing the light cone emanating from the lamp-house (101) of Fig. 12.

The source of light (102) passes through condenser lenses (104) and reflected at right angles by means of mirror (11) and then through convex cylinder lens (12). Both the mirror (11) and lens (12) are stationary while (10) is a rotary series of concave lenses, revolving on axle (124). Lens (12) which is convex and cylindrical is of such strength as to neutralize the concave cylindrical lenses of the rotary series (10). Lens (12) and movable lenses (10) are preferably, though not necessarily, cylindrical shaped. Lenses (10) are preferably ground from one piece of glass, side views of same are shown in Figs. 5—6—7—11—13, and top view with

ary lens (12) then through movable series lenses (10) through stationary aperture (9) then through film aperture (1) and film, and then is reflected again at right angles by means of stationary prism (7). I preferably have prisms silver backed thereby producing better results. After reflection by prism (7) the light passes through stationary but adjustable lens (3), then is again reflected by stationary prism (8) then through stationary but adjustable lens (4), then through movable series of lenses (6) after it leaves lens (6) it goes direct to the screen upon which the image is projected.

The movable series of concave cylindrical lenses (10) Fig. 11 (at the side which intercept the light rays) moves in the opposite direction to the movement of the film viz: The film moves in a downward direction while the concave series of lenses (10) nearest the aperture (9) (the active portions of the lenses (10) intercepting the light) move upward. The directions of movements of both are indicated by arrows in Figs. 5—6—7—11—13. The movement of the film is produced by the large feed sprocket (14) in Fig. 11, being held to it by means of a roller (56ª). The roller (56) is attached to a stationary bearing.

The film (2) from film-reel (60) in magazine (59) passes through fire-valve (58) then is attached to small top feed sprocket (54) by means of roller (56). Said sprocket (54) bears all the tension of the pulling of the film from reel (60). After allowing some slack in the film, it is brought through aperture (1) where there is spring pressure made to bear up the sides in order to straighten out the film for proper projection, and also cause some resistance to its passage past the aperture. The film (2) Fig. 11 is then brought under the roller (126) which acts as the framing device, and then to the large sprocket (14) at the point where roller (56ª) bears upon it. Roller (126) (in framing the picture) is either raised or lowered by means of lever (25) upon fulcrum (24). This method of framing obviates the necessity of adding extra gears to accomplish the same result, which gears would be productive of vibration.

Since rotary series of lenses (6) upon cylindrical drum (13) is attached to same axle (15) which bears the sprocket (14) (front view is shown in Fig. 8) and by referring again to Fig. 11, it can be seen that the rotary series of lenses (6) (on the side which intercept the rays of light) move downward and consequently in the same direction and the rotary series of lenses (6) on drum (13) move synchronously with the film, because I arbitrarily place the same number of lenses (6) on drum (13) as the number of pictures that would move past the film aperture (1) during one complete revolution of the large sprocket (14).

I preferably have a sixteen picture sprocket for sprocket (14) that is sixteen pictures would be propelled past the film aperture (1) with one complete revolution of the sprocket. (The conventional size sprocket is a four picture one).

Since I have a sixteen picture sprocket (14) I must necessarily have sixteen lenses (6) upon drum (13). By moving crank (19) Fig. 11 and Fig. 12 (which propels shaft (15) upon which sprocket (14) and drum (13) are attached) at the rate of one turn per second, which is the commonly used speed of crank, I get the standard sixteen pictures per second past aperture (1). I do not, however, limit myself to sixteen as the number of lenses (6) upon the drum (13) and the corresponding number of pictures per revolution. Thus has been shown how the film moves synchronously with the movable series of lenses (6) on drum (13), and the operation of the novel framing device, and by examining Fig. 11 and Fig. 12 I see the movable series of concave cylinder lenses (10) move in the opposite direction to the movement of the film and synchronously with it.

Upon shaft (15) are attached the sprocket wheel with chain gear (20) and the drum (13).

Upon shaft (124) (which bears concave cylindrical series of lenses) is fixed chain gear sprocket wheel (21) with sprocket 20 which is connected by chain (22), not shown in Fig. 12 as it would obscure some parts of the drawings. The arrows indicate the direction of motion.

I use an adjustable spring (76) pressing against a smooth portion of the revolving part of axle (81) purpose of said spring being to counteract and prevent any variation of motion in the running of parts by momentum.

The film (2) is attached to sprocket (14) by means of roller (56ª) then looped and then attached to bottom take-up sprocket (45) which absorbs all strain and tension of the pulling of bottom terminal film reel (63). The film is passed through fire valve (61) of lower magazine (62) and attached to terminal reel (63).

film.

Fig. 20 shows the mechanical operation of Fig. 13 for clearness omitting certain parts.

The explanation of the optical principle of my machine is as follows:—

In Fig. 1 I have halves of two picture areas on film (2) in the aperture plate (1) and projection lens of the conventional type (3) and (4^a) which project image on screen (5). The passage of the rays of light through the film and lenses, as they are ordinarily projected according to the standard system of projection lenses, naturally forms the image of the halves of the two pictures on the screen.

In Fig. 2 I divide the illumination before it passes through the aperture (1) and film (2) by a method shown in Fig. 7, so that the illumination of the top segment of picture area of film (2) is brought up to be refracted by the top part of lens (3) in such manner that the rays will be refracted by the top part of lens (4^a).

And in like manner the illumination of the bottom segment of picture area of film (2) is brought down to be refracted by the lower part of lens (3) in such manner that the rays will be refracted by the bottom part of lens (4^a). The resulting image on the screen will be the same in either case whether projected as in Fig. 1 or as in Fig. 2 according to the well known principle of lenses.

It will be observed that the previously divided rays of light from the upper segment of picture area on film in Fig. 1 are brought to the lower part of lens (4^a) while in Fig. 2 said rays, having been divided by my scheme, shown in Fig. 7, are brought to the top part of lens (4^a) and the lower segment of picture area on film in Fig. 1 is brought to the upper part of lens (4^a) while in Fig. 2 said rays are brought to the bottom part of lens (4^a). Another difference noted is that in case of Fig. 1 the rays from upper and lower segments are always in close proximity, while in Fig. 2 the rays from the upper and lower segments are widely separated so that the rays from each respective segment will pass properly through their respective lenses of the movable series (6) which will be explained later in more detail.

In Fig. 1 and Fig. 2 the image on screen (5) consists of halves of two pictures since halves of two picture segments are in the aperture (1). By examining Fig. 2 I notice that the rays after passing lens (4^a) are crossed in order to reach their respective segment of image on screen. My invention consists essentially of a method of preventing this said crossing of the rays and thereby reversing the relative position occupied ments of two pictures.

Fig. 3 shows the evolution of my optical scheme in which I substitute two lenses (6^a) for lens (4^a) of Fig. 2 and each unit lens (6^a) being the same strength as lens (4^a). The rays which would otherwise be crossed *en route* to the screen become widely divergent, and I have segments in such relation to each that only a gap between prevents that would otherwise form a complete picture.

Fig. 4 shows the method of juxtaposing the two segments on screen by combining the effect of lens (4^a) of Fig. 2 with the two lenses (6^a) of Fig. 3 in such proportions as to eliminate the gap between the segments on screen in Fig. 3. The lenses (4) and (6) Fig. 4 have a combined strength equal to (6^a) Fig. 3, and the focal length of the combined lenses of Fig. 4 is equal to (4^a) of Fig. 1.

In series of lenses like (6) of Fig. 4 moving synchronously and in the same general direction with the moving film, with a separate lens (6) taking care of each segment of picture areas of the film aperture, by being opposite the film aperture when there is a complete picture in front of aperture, compensating for the motion of the film, secures a complete picture on screen at all times thus eliminating the use of the shutter, of the ordinary machine, which causes the flicker.

Merely having a series of moving lenses to compensate for the film motion, cannot answer the purpose, however, unless the movable series of lenses (6) move steadily without vibration and in a continuous motion, absolutely synchronously with the moving film, and in order to attain these results, I make use of certain optical and mechanical parts and combinations now described, as well as the method of dividing the light cone emanating from the lamp-house (101) of Fig. 12.

The source of light (102) passes through condenser lenses (104) and reflected at right angles by means of mirror (11) and then through convex cylinder lens (12). Both the mirror (11) and lens (12) are stationary while (10) is a rotary series of concave lenses, revolving on axle (124). Lens (12) which is convex and cylindrical is of such strength as to neutralize the concave cylindrical lenses of the rotary series (10). Lens (12) and movable lenses (10) are preferably, though not necessarily, cylindrical shaped. Lenses (10) are preferably ground from one piece of glass, side views of same are shown in Figs. 5—6—7—11—13, and top view with top cut away in Fig. 12.

The light after being reflected by mirror (11) Figs. 11 and 12 passes through station-

ary lens (12) then through movable series lenses (10) through stationary aperture (9) then through film aperture (1) and film, and then is reflected again at right angles by means of stationary prism (7). I preferably have prisms silver backed thereby producing better results. After reflection by prism (7) the light passes through stationary but adjustable lens (3), then is again reflected by stationary prism (8) then through stationary but adjustable lens (4), then through movable series of lenses (6) after it leaves lens (6) it goes direct to the screen upon which the image is projected.

The movable series of concave cylindrical lenses (10) Fig. 11 (at the side which intercept the light rays) moves in the opposite direction to the movement of the film viz: The film moves in a downward direction while the concave series of lenses (10) nearest the aperture (9) (the active portions of the lenses (10) intercepting the light) move upward. The directions of movements of both are indicated by arrows in Figs. 5—6—7—11—13. The movement of the film is produced by the large feed sprocket (14) in Fig. 11, being held to it by means of a roller (56ª). The roller (56) is attached to a stationary bearing.

The film (2) from film-reel (60) in magazine (59) passes through fire-valve (58) then is attached to small top feed sprocket (54) by means of roller (56). Said sprocket (54) bears all the tension of the pulling of the film from reel (60). After allowing some slack in the film, it is brought through aperture (1) where there is spring pressure made to bear up the sides in order to straighten out the film for proper projection, and also cause some resistance to its passage past the aperture. The film (2) Fig. 11 is then brought under the roller (126) which acts as the framing device, and then to the large sprocket (14) at the point where roller (56ª) bears upon it. Roller (126) (in framing the picture) is either raised or lowered by means of lever (25) upon fulcrum (24). This method of framing obviates the necessity of adding extra gears to accomplish the same result, which gears would be productive of vibration.

Since rotary series of lenses (6) upon cylindrical drum (13) is attached to same axle (15) which bears the sprocket (14) (front view is shown in Fig. 8) and by referring again to Fig. 11, it can be seen that the rotary series of lenses (6) (on the side which intercept the rays of light) move downward and consequently in the same direction and substantially parallel with the film (2) though at a greater speed than the movement of the film, because the lenses are revolved upon a circle which diameter is much greater than the diameter of the large sprocket (14) which propels the film, but move synchronously with the film, because I arbitrarily place the same number of lenses (6) on drum (13) as the number of pictures that would move past the film aperture (1) during one complete revolution of the large sprocket (14).

I preferably have a sixteen picture sprocket for sprocket (14) that is sixteen pictures would be propelled past the film aperture (1) with one complete revolution of the sprocket. (The conventional size sprocket is a four picture one).

Since I have a sixteen picture sprocket (14) I must necessarily have sixteen lenses (6) upon drum (13). By moving crank (19) Fig. 11 and Fig. 12 (which propels shaft (15) upon which sprocket (14) and drum (13) are attached) at the rate of one turn per second, which is the commonly used speed of crank, I get the standard sixteen pictures per second past aperture (1). I do not, however, limit myself to sixteen as the number of lenses (6) upon the drum (13) and the corresponding number of pictures per revolution. Thus has been shown how the film moves synchronously with the movable series of lenses (6) on drum (13), and the operation of the novel framing device, and by examining Fig. 11 and Fig. 12 I see the movable series of concave cylinder lenses (10) move in the opposite direction to the movement of the film and synchronously with it.

Upon shaft (15) are attached the sprocket wheel with chain gear (20) and the drum (13).

Upon shaft (124) (which bears concave cylindrical series of lenses) is fixed chain gear sprocket wheel (21) with sprocket 20 which is connected by chain (22), not shown in Fig. 12 as it would obscure some parts of the drawings. The arrows indicate the direction of motion.

I use an adjustable spring (76) pressing against a smooth portion of the revolving part of axle (81) purpose of said spring being to counteract and prevent any variation of motion in the running of parts by momentum.

The film (2) is attached to sprocket (14) by means of roller (56ª) then looped and then attached to bottom take-up sprocket (45) which absorbs all strain and tension of the pulling of bottom terminal film reel (63). The film is passed through fire valve (61) of lower magazine (62) and attached to terminal reel (63).

The extra sprockets (54) and (45) eliminate the variable strain of the feed (60) and terminal (63) film reels and the large sprocket (14) bears only the uniform tension of the portion of the film moving past the film aperture thereby increasing steadiness.

Crank (19) operates axle (15) which also has gear (95) attached, Fig. 12.

Gear (95) operates idler gear (50) upon shaft (52).

Idler (50) operates gear (55) upon shaft (57) to which top-feed sprocket (54) is attached upon bearing support (53).

This same idler (50) also operates gear (46) upon shaft (41) upon which sprocket (45) is attached, upon bearing support (44).

This same shaft (41) also revolves pulley (48), which in turn revolves pulley (100) Fig. 12 by means of belt (49) Fig. 11, (only as dashed lines in Fig. 12.) Pulley (100) revolves shaft (99) to which gear (98) is attached. Gear (98) revolves gear (97) which contributes its motion to shaft (96) which propels bottom film roll (63) Fig. 13.

In Fig. 12 is illustrated the motion of gear (97) contributed to shaft (96) through the medium of a spring which presses upon a collar attached to shaft (96), which is the conventional method of causing shaft (96) to slip when the limit of tension, it can bear, is exceeded.

I use the interception of the two gears (98) and (97) in order to reverse the motion.

Upon shaft (41) Fig. 11 is also attached gear (47) which operates gear (40) upon shaft (51) to which is attached gear (39) and fly-wheel (38) upon bearing (37).

Gear (39) revolves gear (42) to which shaft (35) is attached, upon bearing (36).

Spring governor (94) Fig. 12 is propelled by shaft (35) and when a certain speed is reached it flies out and presses against casing (34) which pulls on lever (33) which operates another lever (32) upon axle (30) which operates fire shutter (31). The fire shutter (31) can be seen in Fig. 11 is omitted from view in Fig. 12.

The lamp-house (101) Fig. 12, may be used in the projection of regular stereoptican views on slides by switching the light from arc (102), to projection lens (115) by means of mirror (113) when it takes the position of (114) which is indicated by dashed lines, which deflect the light at right angles.

The operation of the mirror (113) is accomplished by means of a lever (121). When lever (121) takes the position of (121^a) mirror (113) takes the position of (113^a). Posts (119) and (120) limit the motion of the lever (121).

In Figs. 5—6—7—11—12 the prisms (7) and (8) are used merely to change the direction of the rays and should not be considered in the optical scheme, as they can be omitted as shown in Figs. 13—18 and 19.

I do not restrict myself to having lens two elements having one in back and one in front as in Fig. 10.

The movable series of lenses (10) behind picture divides up the light cone as shown in Figs. 5—6—7.

Fig. 5 illustrates a complete picture of film (2) in front of aperture (1) having correspondingly a complete lens element of series (10) and a complete lens element of series (6) all in optical alinement. The action in this case is the same as with a regular projection lens.

Fig. 6 illustrates a relative position with one quarter of the top picture exposed, and one quarter of the bottom picture correspondingly cut off, and the sum of these two segments form a complete picture on the screen by the actions of the movable series of lenses (10) moving in conjunction and synchronously with the series of lenses (6) and the film (2). Series of movable lenses (6) and film (2) as seen in Figs. 5—6—7 having a downward motion while series of lenses (10) move upward.

In Fig. 7 I have two halves of adjacent pictures on the moving film (2) in front of aperture (1) and correspondingly the halves of two moving lenses of (10) in front of aperture (9) and series of movable lenses (6) in a corresponding synchronous relation.

Gears (17) operate the adjustable properly formed shutter blades (16) equalizing by partially obstructing the light near the optical center where it is slightly stronger Fig. 5 than when projected through the optical edges as in Figs. 6 and 7.

Lens (12) and the movable series (10) divide the light cone from the lamp-house, and after the light cones are reconstructed by the series of lenses (3) (4) and series (6) in front of the film, the relative position of the rays, as indicated by the letters A—B—C—D, as shown on mirror (11) and on screen (5) are the same without regard to the position of the movable elements Figs. 5—6 and 7.

There would be a noticeable flicker if there was a shifting of the rays, since the light passing through the central part of the condenser, as indicated by letter (C) is slightly stronger than the marginal rays (A and D).

It will be observed that my device, as illustrated, provides two apertures (1) and (9) the object of the latter being to control the amount of light at the line of demarcation between the two pictures Figs. 6 and 7 and is equivalent to the top and bottom of image (5).

Aperture (1) must not be smaller than the entire width of the picture area on film. If it is smaller there will be a dark

for mirrors (7) and (8) to introduce within the drum of my mechanism the image of the film which is operated on the outside of the drum. I can accomplish the same result mechanically by twisting the film as indicated in Fig. 14 and specifically demonstrated in Fig. 13.

Figs. 15—16 and 17 show variations and combinations for effecting the same result as specifically illustrated in Fig. 13.

In Fig. 18 the light from the lamp-house is reflected by mirror (114ª) to mirror (11) thence through lens (12) and series of lens (10). The separated cones then pass through film (2) to the refractive system lenses (3) and (4) and movable series (6) (see also Fig. 20) and then on to the screen.

Gear (125) on axis (15) is attached to the inside of the drum (13) carrying the series of lenses (6) and operates also gear (126) rigidly attached to the axis (124) carrying series of lenses (10). Said gear (125) is operated by gear (127) which controls the movement of the film (2) by means of sprocket (14ª).

Friction spring (136) pressing against drum (137) on axis (15) eliminates any possible back motion of drum (13) due to the engaging of the respective gears.

Gear (130) on axle (15ª) operates, as shown by the illustration, gear (129) which transmits its motion to gear (127) and also gear (130) operates gear (132) controlling the bottom take-up sprocket (45) passing the film on to the lower reel and also operates gear (139) attached to gear (138) by a chain which in turn operates top speed sprocket (54) drawing the film (2) from the upper reel not shown in this illustration.

In Fig. 19 is illustrated the device having the light separated between the mirrors (11) and (127) and admits of more freedom in operating the optical dividing system behind the film (2).

For illustrative purposes in the drawings I use simple lenses, but in practice, each lens is a combination of a convex and concave element and of certain shapes, &c., for correction of chromatic, spherical and stigmatic aberrations.

Also I do not wish to restrict myself to any particular form of gearing, or connecting devices, and that I am at liberty to make any slight changes, without departing from the spirit of my invention.

After having described my device, I make the following claims:

1. In a motion picture machine the combination with means for continuously moving the film, an optical ray directing means comprising fixed and movable lenses which upon a revolving drum with the axis of rotation at right angles to the general path of the rays, the lenses on said drum, at the ray affecting side, being movable in the same general direction as the film, means for operating the movable parts in synchronous relation and means for equalizing the intensity of the refracted illumination.

2. In a motion picture machine the combination with means for continuously moving the film, an optical ray directing means, comprising fixed and movable lenses which affect the rays between their source and the film aperture, a projection lens system comprising fixed projection lenses and a movable series corrected convex lenses, fixed upon a revolving drum with its axis of rotation at right angles to the general path of the rays it affects, means for moving said drum of lenses, at the ray affecting side, in the same general direction as the film, fixed plane reflecting means for altering the course of rays laterally, means for operating the movable parts in synchronous relation and means for equalizing the intensity of the refracted illumination.

3. In a motion picture machine the combination with means for continuously moving a film, an optical ray directing means comprising a fixed convex lens system and a revolving series of concave lenses and fixed plane reflecting means between the source of the rays and the film aperture, said revolving series of concave lenses, at the ray affecting side, being movable in an essentially opposite direction to the film movement, a projection lens system comprising fixed projection lenses and a movable series of corrected convex lenses, fixed upon a revolving drum with its axis of rotation at right angles to the general path of the rays it affects, the lenses on said drum, at the ray affecting side, being movable in the same general direction as the film, fixed plane reflecting means for altering the course of rays laterally, means for operating the movable parts in synchronous relation.

4. In a motion picture machine the combination with means for continuously moving a film, an optical ray directing means comprising a fixed convex lens system and a revolving series of concave lenses and fixed plane reflecting means between the source of the rays and the film aperture, said revolving series of concave lenses, at the ray affecting side being movable in an essentially opposite direction to the film movement, a projection lens system comprising fixed projection lenses and a movable series of corrected convex lenses, fixed upon a revolving drum with its axis of rotation at

has gear (95) attached, Fig. 12.

Gear (95) operates idler gear (50) upon shaft (52).

Idler (50) operates gear (55) upon shaft (57) to which top-feed sprocket (54) is attached upon bearing support (53).

This same idler (50) also operates gear (46) upon shaft (41) upon which sprocket (45) is attached, upon bearing support (44).

This same shaft (41) also revolves pulley (48), which in turn revolves pulley (100) Fig. 12 by means of belt (49) Fig. 11, (only as dashed lines in Fig. 12.) Pulley (100) revolves shaft (99) to which gear (98) is attached. Gear (98) revolves gear (97) which contributes its motion to shaft (96) which propels bottom film roll (63) Fig. 13.

In Fig. 12 is illustrated the motion of gear (97) contributed to shaft (96) through the medium of a spring which presses upon a collar attached to shaft (96), which is the conventional method of causing shaft (96) to slip when the limit of tension, it can bear, is exceeded.

I use the interception of the two gears (98) and (97) in order to reverse the motion.

Upon shaft (41) Fig. 11 is also attached gear (47) which operates gear (40) upon shaft (51) to which is attached gear (39) and fly-wheel (38) upon bearing (37).

Gear (39) revolves gear (42) to which shaft (35) is attached, upon bearing (36).

Spring governor (94) Fig. 12 is propelled by shaft (35) and when a certain speed is reached it flies out and presses against casing (34) which pulls on lever (33) which operates another lever (32) upon axle (30) which operates fire shutter (31). The fire shutter (31) can be seen in Fig. 11 is omitted from view in Fig. 12.

The lamp-house (101) Fig. 12, may be used in the projection of regular stereoptican views on slides by switching the light from arc (102) to projection lens (115) by means of mirror (113) when it takes the position of (114) which is indicated by dashed lines, which deflect the light at right angles.

The operation of the mirror (113) is accomplished by means of a lever (121). When lever (121) takes the position of (121^a) mirror (113) takes the position of (113^a). Posts (119) and (120) limit the motion of the lever (121).

In Figs. 5—6—7—11—12 the prisms (7) and (8) are used merely to change the direction of the rays and should not be considered in the optical scheme, as they can be omitted as shown in Figs. 13—18 and 19.

I do not restrict myself to having lens (4) behind movable series (6). Lens (4) may be in front of the series lenses (6) as in Fig. 9 or lens (4) may be separated into

front as in Fig. 10.

The movable series of lenses (10) behind picture divides up the light cone as shown in Figs. 5—6—7.

Fig. 5 illustrates a complete picture of film (2) in front of aperture (1) having correspondingly a complete lens element of series (10) and a complete lens element of series (6) all in optical alinement. The action in this case is the same as with a regular projection lens.

Fig. 6 illustrates a relative position with one quarter of the top picture exposed, and one quarter of the bottom picture correspondingly cut off, and the sum of these two segments form a complete picture on the screen by the actions of the movable series of lenses (10) moving in conjunction and synchronously with the series of lenses (6) and the film (2). Series of movable lenses (6) and film (2) as seen in Figs. 5—6—7 having a downward motion while series of lenses (10) move upward.

In Fig. 7 I have two halves of adjacent pictures on the moving film (2) in front of aperture (1) and correspondingly the halves of two moving lenses of (10) in front of aperture (9) and series of movable lenses (6) in a corresponding synchronous relation.

Gears (17) operate the adjustable properly formed shutter blades (16) equalizing by partially obstructing the light near the optical center where it is slightly stronger Fig. 5 than when projected through the optical edges as in Figs. 6 and 7.

Lens (12) and the movable series (10) divide the light cone from the lamp-house, and after the light cones are reconstructed by the series of lenses (3) (4) and series (6) in front of the film, the relative position of the rays, as indicated by the letters A—B—C—D, as shown on mirror (11) and on screen (5) are the same without regard to the position of the movable elements Figs. 5—6 and 7.

There would be a noticeable flicker if there was a shifting of the rays, since the light passing through the central part of the condenser, as indicated by letter (C) is slightly stronger than the marginal rays (A and D).

It will be observed that my device, as illustrated, provides two apertures (1) and (9) the object of the latter being to control the amount of light at the line of demarcation between the two pictures Figs. 6 and 7 and is equivalent to the top and bottom of image (5).

Aperture (1) must not be smaller than the entire width of the picture area on film. If it is smaller there will be a dark line of demarcation between the juxtaposed image on screen (5).

My device, as above illustrated, provides

the drum of my mechanism the image of the film which is operated on the outside of the drum. I can accomplish the same result mechanically by twisting the film as indicated in Fig. 14 and specifically demonstrated in Fig. 13.

Figs. 15—16 and 17 show variations and combinations for effecting the same result as specifically illustrated in Fig. 13.

In Fig. 18 the light from the lamp-house is reflected by mirror (114^a) to mirror (11) thence through lens (12) and series of lens (10). The separated cones then pass through film (2) to the refractive system lenses (3) and (4) and movable series (6) (see also Fig. 20) and then on to the screen.

Gear (125) on axis (15) is attached to the inside of the drum (13) carrying the series of lenses (6) and operates also gear (126) rigidly attached to the axis (124) carrying series of lenses (10). Said gear (125) is operated by gear (127) which controls the movement of the film (2) by means of sprocket (14^a).

Friction spring (136) pressing against drum (137) on axis (15) eliminates any possible back motion of drum (13) due to the engaging of the respective gears.

Gear (130) on axle (15^a) operates, as shown by the illustration, gear (129) which transmits its motion to gear (127) and also gear (130) operates gear (132) controlling the bottom take-up sprocket (45) passing the film on to the lower reel and also operates gear (139) attached to gear (138) by a chain which in turn operates top speed sprocket (54) drawing the film (2) from the upper reel not shown in this illustration.

In Fig. 19 is illustrated the device having the light separated between the mirrors (11) and (127) and admits of more freedom in operating the optical dividing system behind the film (2).

For illustrative purposes in the drawings I use simple lenses, but in practice, each lens is a combination of a convex and concave element and of certain shapes, &c., for correction of chromatic, spherical and stigmatic aberrations.

Also I do not wish to restrict myself to any particular form of gearing, or connecting devices, and that I am at liberty to make any slight changes, without departing from the spirit of my invention.

After having described my device, I make the following claims:

1. In a motion picture machine the combination with means for continuously moving the film, an optical ray directing means comprising fixed and movable lenses which affect the rays between their source and the film aperture, a projection lens system comprising fixed projection lenses and a movable series of corrected convex lenses, fixed upon a revolving drum with its axis of rotation at right angles to the general path of the rays, the lenses on said drum, at the ray affecting side, being movable in the same general direction as the film, means for operating the movable parts in synchronous relation and means for equalizing the intensity of the refracted illumination.

2. In a motion picture machine the combination with means for continuously moving the film, an optical ray directing means, comprising fixed and movable lenses which affect the rays between their source and the film aperture, a projection lens system comprising fixed projection lenses and a movable series corrected convex lenses, fixed upon a revolving drum with its axis of rotation at right angles to the general path of the rays it affects, means for moving said drum of lenses, at the ray affecting side, in the same general direction as the film, fixed plane reflecting means for altering the course of rays laterally, means for operating the movable parts in synchronous relation and means for equalizing the intensity of the refracted illumination.

3. In a motion picture machine the combination with means for continuously moving a film, an optical ray directing means comprising a fixed convex lens system and a revolving series of concave lenses and fixed plane reflecting means between the source of the rays and the film aperture. said revolving series of concave lenses, at the ray affecting side, being movable in an essentially opposite direction to the film movement, a projection lens system comprising fixed projection lenses and a movable series of corrected convex lenses, fixed upon a revolving drum with its axis of rotation at right angles to the general path of the rays it affects, the lenses on said drum, at the ray affecting side, being movable in the same general direction as the film, fixed plane reflecting means for altering the course of rays laterally, means for operating the movable parts in synchronous relation.

4. In a motion picture machine the combination with means for continuously moving a film, an optical ray directing means comprising a fixed convex lens system and a revolving series of concave lenses and fixed plane reflecting means between the source of the rays and the film aperture, said revolving series of concave lenses, at the ray affecting side being movable in an essentially opposite direction to the film movement, a projection lens system comprising fixed projection lenses and a movable series of corrected convex lenses, fixed upon a revolving drum with its axis of rotation at right angles to the general path of the rays it affects, the lenses on said drum, at the ray affecting side, being movable in the same general direction as the film, fixed plane re-

flecting means for altering the course of rays laterally, means for operating the movable parts in synchronous relation and means for equalizing the intensity of the refracted illumination.

5. In a motion picture machine the combination with means for continuously moving a film, an optical ray directing system comprising a fixed convex lens system and a revolving series of concave lenses with fixed plane reflecting means, a projection lens system comprising fixed and movable projection lenses with means for equalizing the intensity of the refracted illumination and means for operating the movable parts in synchronous relation substantially as described and for the purposes set forth.

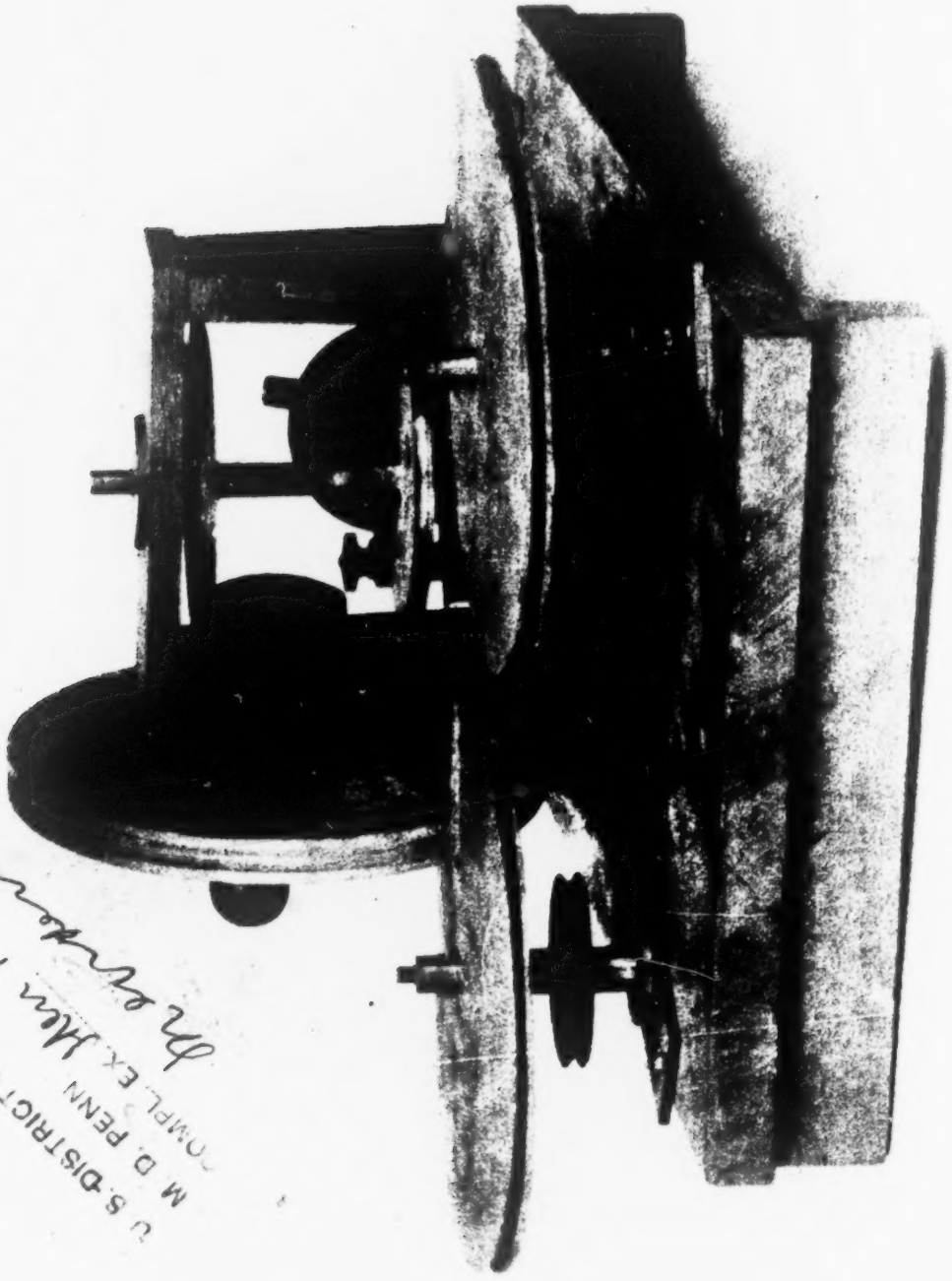
6. In a motion picture machine the combination with means for continuously moving the film, a projection lens system comprising fixed and movable projection lenses with fixed plane reflecting diverters, means for equalizing the intensity of the refracted illumination, an optical ray directing system, comprising a fixed convex lens system and a revolving series of concave lenses and fixed plane reflecting means located between the source of light and the film aperture, said revolving series of concave lenses, at the ray affecting side, movable in an essentially opposite direction to the film movement and means for operating the movable parts in synchronous relation.

7. In a motion picture apparatus the combination with means for continuously moving the film, ray directing means comprising fixed and movable optical elements located between the source of light and the film aperture, a projection lens system comprising fixed and movable projection lenses, means for operating all the movable parts in synchronous relation and means for equalizing the intensity of refracted illumination consisting of two properly formed shutter blades which operate by partially obstructing the stronger centrally refracted rays substantially as described.

SAMUEL BARDY.

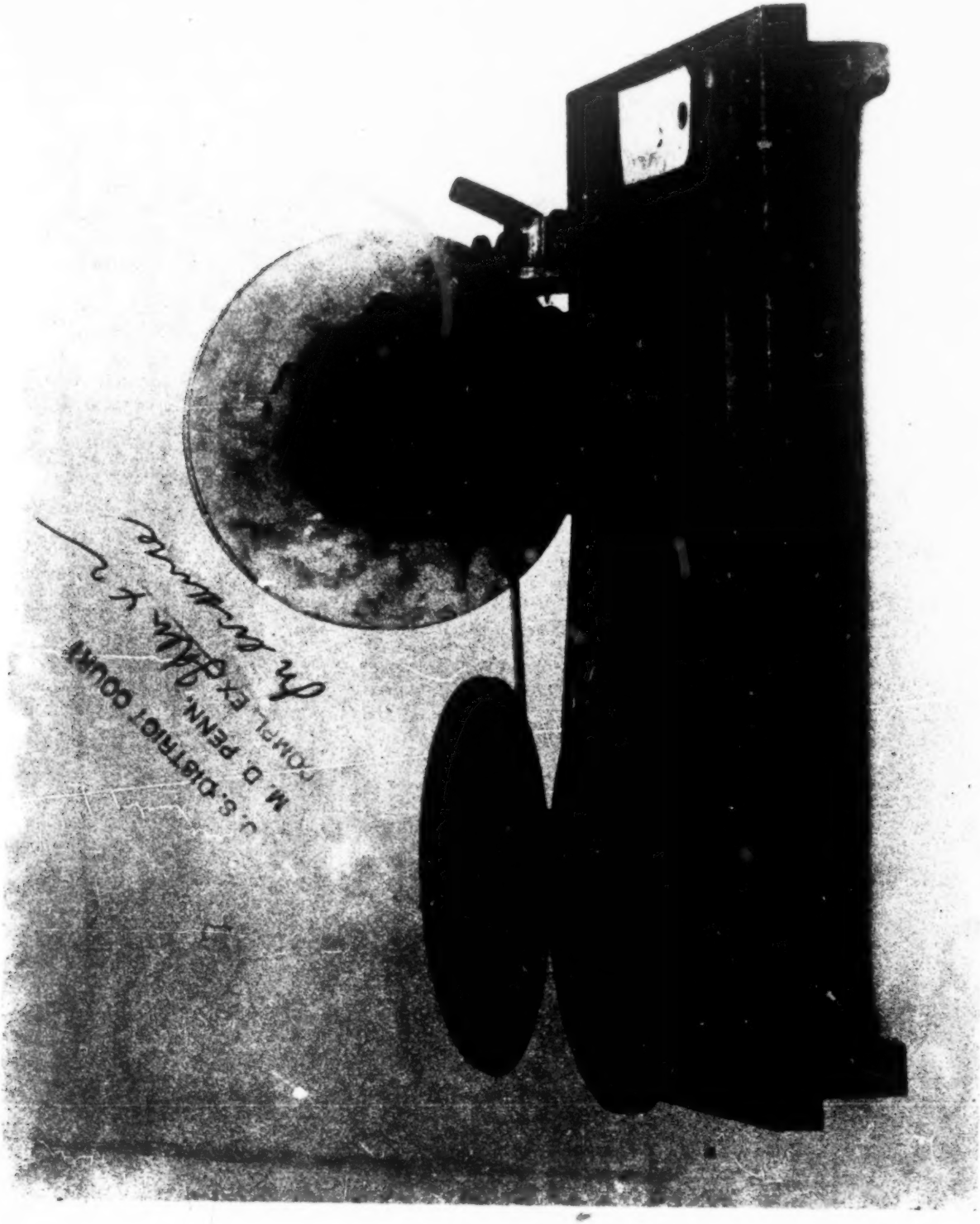
Witnesses:
ALLEN B. CLEMENT,
ARTHUR H. SCHERER.

PLAINTIFFS' EXHIBIT NO. 41.



U.S. DISTRICT COURT
M.D. PENN
COMPL. EX.

PLAINTIFFS' EXHIBIT NO. 42.

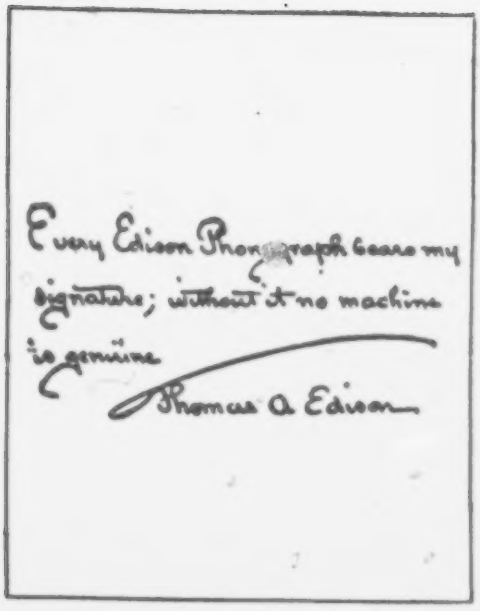


A CATALOGUE OF

EDISON PHONOGRAPHS AND RECORDS

REPRODUCERS
ATTACHMENTS AND
ACCESSORIES

THOMAS A. EDISON, INC.
ORANGE, N. J.



EVERY EDISON PHONOGRAPH and every Edison Record and Blank is sold by THOMAS A. EDISON, INCORPORATED, under restrictions as to the persons to whom and the prices at which such Phonographs, Records and Blanks are to be sold and as to the renewal or change in whole or in part of the serial numbers on such Phonographs. Any violation of such restrictions terminates the license to use and vend such Phonographs, Records and Blanks implied from the sale thereof, and any subsequent use or sale of such Phonographs, Records and Blanks is an infringement of the patents under which same are manufactured.

THOMAS A. EDISON, INC.
ORANGE, N. J., U. S. A.

Form No. 2008. 904-H.

Why You Want One

YOU want an Edison Phonograph because it's the Phonograph with the right volume of sound for the home. Even when a record by a full band is being played, you get all the beautiful music of the band with a volume pleasing to the ear. To get this volume on the Edison requires no manipulation of the Phonograph or the reproducer. Both are always just right.

You want an Edison Phonograph because it's the Phonograph with which you can make your own records at home. If it had no other good points this feature alone should decide you in favor of the Edison. Making your own records is interesting, entertaining, amusing, instructive and educational. There is a fascination about doing it unlike anything you have ever done before. It is an

experience that fills you with awe at the marvel of it. You talk or sing into a horn; you hear and see the sapphire cutting into the wax, each sound wave different from all others. Then you put on a reproducer and your voice comes back to you. It is a wonderful and mysterious process, and when you do it you accomplish something that was unknown to the entire world until Mr. Edison in 1877 discovered the principle of sound reproduction and added to his great fame as an inventor.

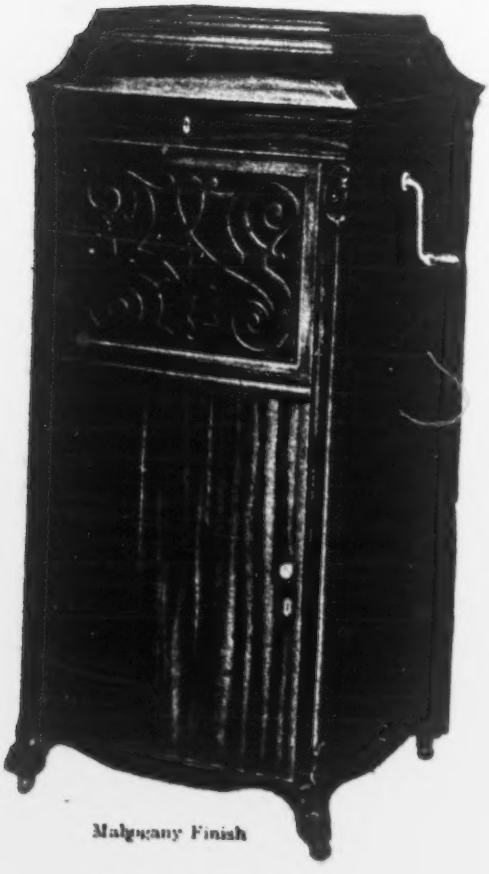
You want an Edison Phonograph because it's the Phonograph that has the permanent, smooth sapphire point which brings out all of the fine qualities of the music and does not require changing with each new record.

You want an Edison Phonograph because it's the Phonograph with the smoothest records—the kind of records that give the finest tones of the most delicate string instruments without the harsh, scratchy, hissing noises so common in some machines and so offensive to the musical ear.

You want an Edison Phonograph because it's the Phonograph with the Amberol Record, playing over four minutes. Until Mr. Edison devised the Amberol Record many good musical compositions and songs could not be given complete.

You want an Edison Phonograph because it's the Phonograph that will give you the best in music, whether it be grand opera, old time songs, sentimental ballads, sacred selections, band, orchestra or other instrumental selections, all by the leading artists of the world. The Edison record catalogues contain about 8,000 different selections.

You want an Edison Phonograph because it's the Phonograph that Mr. Edison invented, improved and is still working upon. When you get an Edison you know that it is the Phonograph he believes to be the best in existence.



Mahogany Finish

Edison Amberola
$200.00

Edison Amberola Phonograph B1

Oak or Mahogany, $200.00
Circassian Walnut, $250.00

Cabinet—Mission or golden oak; piano finish or dull finish mahogany; or Circassian walnut. Has four drawers with a capacity for 100 Edison Records.

Finish of Mechanism and Parts—Dark red and gilt enamel and oxidized bronze, or gun metal with oak cabinets.

Horn—Entirely concealed in cabinet.

Mandrel—Oxidized bronze, highly polished, firmly supported to insure steady and uniform reproduction. Will play only Amberol Records.

Motor—New style with powerful double springs and improved motor suspension, direct drive, without belt. Runs noiselessly, regulates perfectly; can be wound while playing. Will play five Amberol Records with one winding.

Machine Features—Equipped with automatic stop of new design. This can be set while Records are being played, is adjustable to all Amberol Records, and stops motor gradually and without noise. The governor is of the four-ball type. The speed adjusting screw is mounted on the rear of the top plate. Mandrel travels while reproducer is stationary.

Reproducer—New style Model L, playing Amberol Records only. This Reproducer is held rigidly in the body of the Phonograph, the mandrel feeding the record to and from the sapphire reproducing point. The highly polished sapphire point will last indefinitely and does not require changing.

Size of Machine Height, 42 inches; width, 21 inches; depth, 22 inches.

Weight packed 315 Lb.

10/1/11

Edison Opera Phonograph
$90.00

Edison Opera Phonograph

Plays Amberol Records Only

Price, $90.00

Cabinet—Mahogany, new design with cover to match, both with special piano finish. Handles assembled to cabinet, making the Phonograph portable.

Finish—Maroon enamel with gilt decorations, movable mandrel, gun metal plated and polished.

Motor—Powerful double springs. Motor geared to body, thus eliminating the use of driving belts and insuring perfect regulation and noiseless operation.

Reproducer—New style Model L, intended for use on Amberol Records which this Phonograph plays exclusively. This reproducer is held rigidly in the body of the Phonograph, the mandrel feeding the record to and from the sapphire reproducing point.

Horn—Self-supporting mahogany wood Cygnet horn with special piano finish to match cabinet. This horn does not need a crane, as the stem fits into the reproducer arm which is a part of the Phonograph body, and is held firmly in place at the proper angle. The horn, however, by an ingenious swivel arrangement of the horn socket, may be turned in any direction while the Phonograph is playing without changing the angle or interfering with the reproduction of sound.

Recorder—A Recorder is not included in this equipment as this Phonograph plays Amberol Records only.

400

Edison Triumph Phonograph
$75.00

Edison Triumph Phonograph

Combination Type

Price, $75.00

Cabinet—Antique oak, new style design, with cover to match, both highly polished.

Finish of Mechanism and Parts—Black and gilt enamel.

Horn—Edison wood Cygnet horn, oak; bell 21½ inches wide, with curved stem, making total length 36 inches. Supported by nickel-plated swinging crane. Options: Edison wood Cygnet horn, spruce, $5.00 extra; inlaid pearl, $45.00 extra.

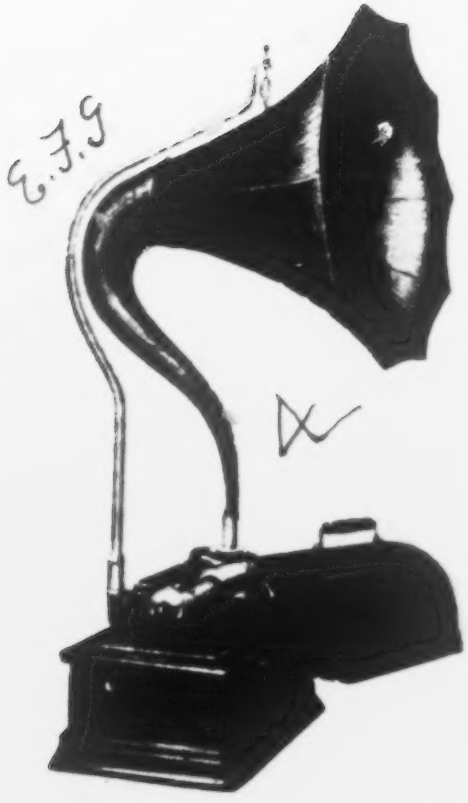
Mandrel—Nickel-plated and polished; firmly supported to insure steady and uniform reproduction. Will play all Edison Records.

Motor—Powerful triple springs, with improved motor suspension. Runs noiselessly, regulates perfectly, and can be wound while running.

Reproducer—New style Model O, playing Amberol and Standard Records. An ingenious arrangement makes it easy to change from Amberol Records to Standard Records and back again without removing the reproducer from the arm. Its highly polished sapphire points will last indefinitely and do not require changing.

Recorder—An improved Edison Recorder, for home Record making. An adapter ring will be furnished so that the Recorder can be used in arm of Model O Reproducer.

Size of Machine—Height, 13¼ inches. Base, 18 x 12¾ inches. Weight, net 50½ lbs.; gross, 97 lbs. Packed in one case. Horn packed in crate, gross weight, 24 lbs.



Edison Home Phonograph
$50.00

Edison Home Phonograph

Combination Type

Price, $50.00

Cabinet—Antique oak, new style design, with cover to match, both highly polished.

Finish of Mechanism and Parts—Black and gilt enamel.

Horn—Edison Cygnet, metal, oak finish; bell (11 petals), 21 inches wide with curved stem, making total length 36 inches. Supported by nickel-plated swinging crane. Options: Edison wood Cygnet horn, oak, $5.00 extra; spruce, $10.00 extra; inlaid pearl, $40.00 extra.

Mandrel—Nickel-plated and polished; firmly supported to insure steady and uniform reproduction. Will play all Edison Records.

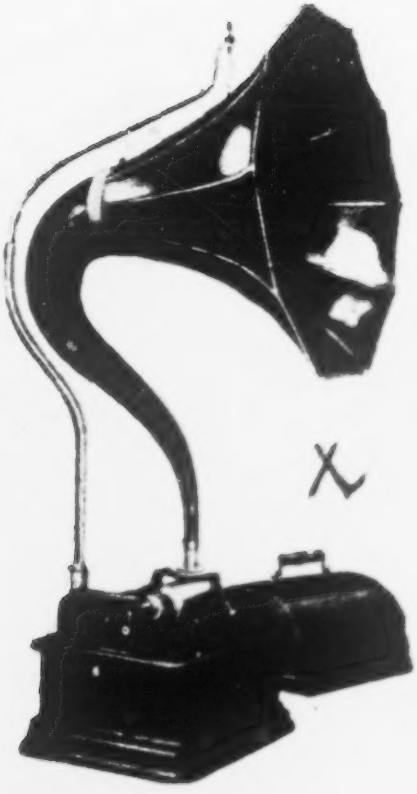
Motor—Extra strong single spring, with improved motor suspension. Runs noiselessly; regulates perfectly.

Reproducer—New style Model O, playing Amberol and Standard Records. An ingenious arrangement makes it easy to change from Amberol Records to Standard Records and back again without removing the reproducer from the arm. Its highly polished sapphire points will last indefinitely and do not require changing.

Recorder—An improved Edison Recorder, for home Record making. An adapter ring will be furnished so that the Recorder can be used in arm of Model O Reproducer.

Size of Machine—Height, 11¼ inches. Base, 16⅜ x 9¼ inches. Weight, net, 30 lbs.; gross, 58 lbs. Packed in one case. Horn packed in crate, weight, 22 lbs.

E.T.S.



Edison Standard Phonograph
$35.00

Edison Standard Phonograph

Combination Type

Price, $35.00

Cabinet—Antique oak, new style design, with cover to match, both highly polished.

Finish of Mechanism and Parts—Black and gilt enamel.

Horn—Edison Cygnet, metal, black japanned; bell (10 petals), 19 inches wide with curved stem, making total length 38 inches. Supported by nickel-plated swinging crane. Option: Edison Cygnet horn, oak finish, $5.00 extra; wood Cygnet horn, oak, $10.00 extra; spruce, $15.00 extra; inlaid pearl, $45.00 extra.

Mandrel—Nickel-plated and polished; firmly supported to insure steady and uniform reproduction. Will play all Edison Records.

Motor—Powerful single spring; with improved motor suspension. Runs noiselessly, regulates perfectly.

Reproducer—New style Model S, playing Amberol and Standard Records. A pointer attached to the swivel plate enables the user to properly set the sapphires in position for playing with Amberol or Standard Records. The highly polished sapphire points will play indefinitely and do not require changing.

A Reconler is not included in the Standard Phonograph equipment. It costs $3.00. (See page 33.)

Size of Machine—Height, 11¼ inches. Base, 13½ x 9½ inches. Weight net, 21½ lbs.; gross, 43 lbs. Packed in one case. Horn packed in crate, weight, 19 lbs.

Edison
Standard Phonograph
(Four-Minute only)
$30.00

Edison Standard Phonograph

Plays Amberol Records Only

Price, $30.00

Cabinet—Antique Oak with cover to match, both highly polished. Handle assembled to cover, making the Phonograph portable.

Finish—Black enamel with gilt decorations. Mandrel nickel-plated and polished.

Horn—Blue japanned with chrysanthemum decoration inside of bell. Polygonal shape, 30 inches long, 10 petals, supported by nickel-plated swinging crane. No horn options on this outfit.

Motor—Powerful single spring with improved motor suspension insuring perfect regulation and noiseless operation.

Reproducer—New style Model N, playing Amberol Records only. This reproducer has a large diaphragm, producing a mellower tone and greater definition than the smaller Model H. Its highly polished sapphire point will play indefinitely and does not require changing with each new record.

Recorder—A Recorder is not included in this equipment as this Phonograph plays Amberol Records only.

Size of Machine—Height, 11 ¼ inches. Base, 13 ½ x 9 ½ inches. Weight, net, 21 ½ lbs.; gross, 42 lbs. Packed in one case. Horn packed in crate, weight, 19 lbs.

Edison
Fireside
Phonograph
$22.00

Edison
Fireside
Phonograph
With
Cygnet
Horn
$27.00

Edison Fireside Phonograph

Combination Type

Price, $22.00

Cabinet—Antique oak, new style design, with cover to match, both highly polished.

Finish of Mechanism and Parts—Black and gilt enamel.

Horn—Fireside type sectional horn, maroon japanned with gilt decorations; 19 inches long; bell (8 petals) 11 inches wide. Supported by nickel-plated crane Option: Edison Cygnet horn, black japanned finish, $5.00 extra; oak finish, $10.00 extra; wood Cygnet horn oak, $15.00 extra; spruce, $20.00 extra; inlaid pearl, $50.00.

Mandrel—Nickel-plated and polished. Will play all Edison Records.

Motor—Newly designed, single spring; runs noiselessly. Can be wound while running. Improved start and stop regulating device

Reproducer—New style combination Model K, having two highly polished sapphire points for playing both two and four-minute Records. These points do not scratch and do not require changing.

A Recorder is not included in the Fireside equipment. It costs $3.00. (See page 33.)

Size of Machine—Height, 11 inches. Base, 9¼ x 11¾ inches. Weight, net, 18 lbs.; gross, 42 lbs. Packed in one case. Horn packed with machine

Edison Gem Phonograph
$15.00

Edison Gem Phonograph

Combination Type

Price, $15.00

Metal Body Box—Finished in maroon and gilt enamel, stands on a polished oak base; has antique oak cover.

Horn—Fireside type sectional horn, maroon japanned, with gilt decorations; 19 inches long; bell (8 petals), 11 inches wide. Supported by nickel-plated crane.

Mandrel—Nickel-plated and polished. Will play all Edison Records.

Motor—Newly designed single spring; runs noiselessly. Improved start and stop regulating device.

Reproducer—New style combination Model K, having two highly polished sapphire points for playing both two and four-minute Records. These points do not scratch and do not require changing.

A Recorder is not included in the Gem equipment. It costs $3.00. (See page 33.)

Size of Machine—Height, 8 inches. Base, 10 x 7¼ inches. Weight, net, 14½ lbs.; gross, 34 lbs. Packed in one case. Horn packed with machine.

Edison Alva Phonograph
Electrically Operated
$100.00

Edison Alva Phonograph

Combination Type

Price, $100.00

Only Electrically Operated Edison Phonograph

Fitted with a universal motor that will operate on either direct or alternating current.

Cabinet—Antique oak, new style design, with cover to match, both highly polished.

Finish of Mechanism and Parts—Black and gilt enamel.

Horn—Edison wood Cygnet horn, oak; bell 21½ inches wide with curved stem, making total length 36 inches. Supported by nickel-plated swinging crane. Options: Edison wood Cygnet horn, spruce, $5.00 extra; inlaid pearl, $35.00 extra.

Mandrel—Nickel-plated and polished; firmly supported to insure steady and uniform reproduction. Will play all Edison Records.

Reproducer—New style Model O, playing Amberol and Standard Records. An ingenious arrangement makes it easy to change from Amberol Records to Standard Records and back again without removing the reproducer from the arm. Its highly polished sapphire points will last indefinitely and do not require changing.

Recorder—An improved Edison Recorder, for home Record making. An adapter ring will be furnished so that Recorder can be used in arm of Model O Reproducer.

Size of Machine—Height, 13¾ inches. Base, 18 x 12½ inches. Weight, net, 45 lbs.: gross, 95 lbs. Packed in one case. Horn packed in crate, gross weight, 24 lbs.

Edison Phonograph Reproducers

THE Reproducer is the most vital part of a talking machine. On it depends sweetness, clearness and fidelity in reproducing sounds. Edison Reproducers have done more to make the Phonograph famous than any other one feature.

The reproducing points on Edison Reproducers absolutely prevent the harsh, disagreeable scratching sounds often noticed in instruments having changeable points. They do not require changing.

Because of the absence of scratch and wear, Edison Records, after many reproductions, are clear, distinct and musical. This exclusive feature of the Edison Phonograph should have the most careful consideration of intending purchasers.

Model C, $3.50

THIS Reproducer is designed for use on the Edison Standard (two-minute) Record only. It has a button-shaped sapphire of the proper size to fit in the special grooves of the record, which are cut 100 to the inch. This sapphire is finely

ground and highly polished and does not wear itself or the records. The Model C should not be used on Amberol Records.

Model H, $3.50

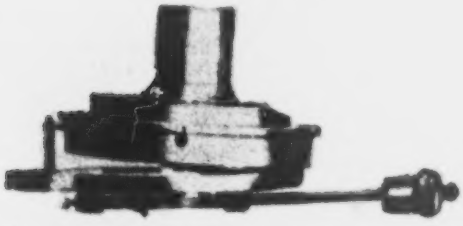
THIS Reproducer is designed for use on the Amberol Record *only*. The sapphire is much smaller than the Model C and of the proper size to fit the grooves of the Amberol Record, which are cut 200 to the inch. Does not wear or require changing.

Model K, $5.00

THIS Reproducer is provided with two sapphires assembled to the weight and mounted on a swivel plate for the purpose of playing either the two or four-minute Records, and can be used in place of either Model C or H Reproducer or both.

A pointer attached to the swivel plate enables the user to properly set the sapphire in position for playing either the two or four-minute Record.

Model O, $10.00

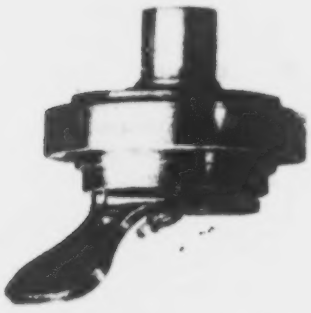


THIS Reproducer is fitted with a large diaphragm, producing a mellower tone and greater definition than the smaller Models C, H and K.

It is a Combination Reproducer, having two sapphires assembled to the same arm either of which may be set in position for playing either two or four-minute Records. This change can be made without removing the Reproducer from the arm of the Phonograph, by turning the indicator rod to correspond with the Record to be played.

This Reproducer can be used on Home, Triumph and Alva Phonographs when equipped with attachments for playing both Records.

Model R, $5.00



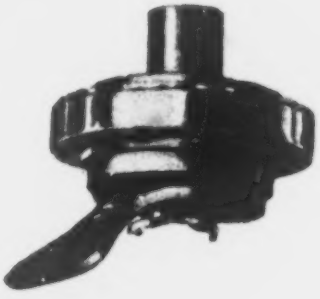
THIS Reproducer is fitted with a large diaphragm, producing a mellower tone and greater definition than the smaller Models H and K.

It is a four-minute Reproducer intended for use on the Amberol Records only.

The sapphire point is much smaller than the Model C, and is highly polished to proper size to fit the grooves of the Amberol Record which are cut 200 to the inch. Does not wear or require changing.

This Reproducer is designed to fit all types of Phonographs now in use when equipped with attachments for playing Amberol Records.

Model S, ~~$60.00~~ 6.50



THIS Reproducer is fitted with a large diaphragm, producing a mellower tone and greater definition than the smaller Models C, H and K.

It is a combination Reproducer, fitted with two sapphires mounted on a swivel plate for the purpose of playing either the two or four-minute Record and can be used in place of either Models C, H or K.

A pointer attached to the swivel plate enables the user to properly set the sapphires in position for playing either the two or four-minute Record.

This Reproducer can be used on all types of Phonographs now in use when equipped with attachments for playing both Records.

Edison Grand Opera Records

Amberol (FOUR-MINUTE)
$1.00, $1.50 and $2.00
Standard (TWO-MINUTE), **75 cents**

EDISON Grand Opera Records are sold at higher prices because the masters are made by Grand Opera artists of the first rank. Among the great artists who have made or are now making Grand Opera Records for the Edison Phonograph are: Leo Slezak, the famous tenor, Riccardo Martin, Carmen Melis, Marguerita Sylva, Florencio Constantino, Karl Jörn, Marie Delna, Adelina Agostinelli, Gustave Huberdeau, Walter Soomer, Blanche Arral, Antonio Scotti, Bessie Abbott, Marie Rappold, Heinrich Knote, Josephine Jacoby, Anton Van Rooy, and others. Ask your dealer or write to Thomas A. Edison, Inc., for complete catalogue.

Edison Amberol Records

Price, 50 cents

EDISON Amberol or Four-Minute Records are a remarkable achievement in the art of reproducing sound, and only the genius of Mr. Edison has made them possible. Their important feature is a recording thread of 200 lines to the inch, or twice as fine as the Standard Record of 100 threads. By this finer thread twice the playing length is secured without increasing the length or diameter of the Record itself. It will play four and one-half minutes. The Record is made by a new process and a new and harder composition is used. Nothing has been lost by the finer thread; on the contrary, Amberol Records are even better than the Standard Records.

Edison Amberol Records now include nearly 900 selections. Not all of these selections are new in the sense that they have not been heard before. They are new on the

Amberol Records, which make it possible not only to present long pieces entire, but also to give better renditions of these pieces than could be done on the shorter Records. Then, too, selections that were never included in the Edison Standard Records will now be included in the Edison Amberol Records.

The catalogue of Amberol Records gives a wide range of good music, popular music, amusing music and other entertainment.

Edison Concert Records

Price, 75 cents

EDISON Concert Records are made by the old style wax process and can only be played on Phonographs having a mandrel five inches in diameter. We have discontinued the manufacture of Phonographs of this kind. Concert Records are made to order only, simply to supply machines of this type (playing the two-minute Record) now in use.

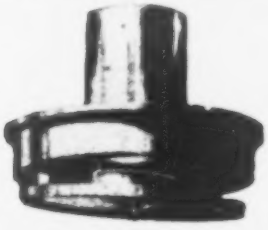
Edison Standard Records

Price, 35 cents

EDISON Standard Records are the moulded Records that have been before the public since the spring of 1902. They are today better than ever before. No effort will be spared to make them still better. Edison Standard Records are made with 100 threads to the inch, or, in other words, they have 100 engraved lines to each inch of length. This gives them a playing length of from two to two and a half minutes.

The catalogue of Edison Standard Records comprises about 1,300 selections, including everything that is worth while in music, songs and humorous selections.

The introduction of the Amberol Records has caused no let-up in the quality of the Standard Records, for as great pains as ever before are being taken to keep up their high character.



Edison Recorder

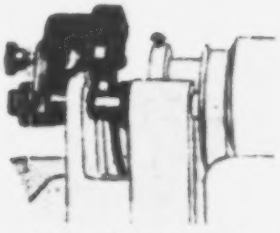
Price, $3.00

THE Edison Recorder is a wonderful device by which the owner of an Edison Phonograph may make his own Records. It embodies all the important features of the recorders used at the Edison Laboratory in making the masters from which Edison Moulded Records are made. It adjusts itself automatically to every sound, making an even and deep cut in the surface of a wax cylinder. It is furnished with a recording stylus only.

Phonograph owners not possessing a Recorder should get one, with a supply of blanks, and practice making records at home. Those who have not tried this will find it a source of much amusement. It will furnish a new use for the Phonograph.

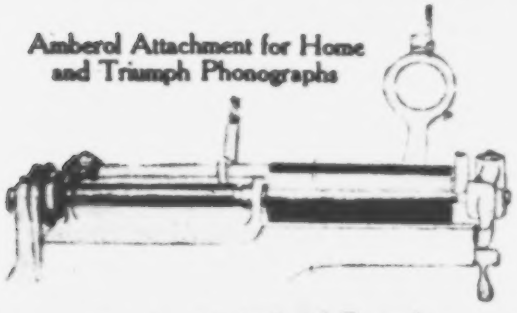
The Edison Recorder can only be used when Phonographs are adjusted to play Standard Records.

Amberol Attachment for Gem Phonograph



Amberol Attachment for Standard Phonograph

Amberol Attachment for Home and Triumph Phonographs



Ten Special Amberol Records

Attachments for Playing Amberol Records

With 10 Special Amberol Records

For Gem Phonograph	$5.00
For Standard Phonograph	6.00
For Home and Triumph Phonographs	8.50
For Concert Phonograph	10.75

A Model H Reproducer is also included in each of these Attachments.

(For Concert Phonographs, see page 36.)

Simple and easily applied attachments have been designed by which all types of Edison Phonographs may be equipped to play the new Amberol Records. These attachments embody the principles of the differential gear and include an additional Reproducer known as the Model H. This model has a smaller reproducing point, but possesses all the advantages of the Model C Reproducer.

As an inducement to Phonograph owners to equip their machines with Amberol attachments, ten special Amberol Records are being included with each attachment, the cost of the complete outfit being but little more than the cost of the attachment alone. These special records are equal in every respect to any in the regular catalogue. They can only be had with an attachment. Ask a dealer for detailed information about this proposition. These attachments are sold without the ten special Records, as follows:

For Gem Phonograph	$4.00
For Standard Phonograph	5.00
For Home and Triumph Phonographs	7.50

Concert Phonograph Attachments

Attachment to play Standard and Amberol Records	$9.75
Attachment to play Standard and Amberol Records on Concert Phonographs that have been converted to play Standard Records	7.50

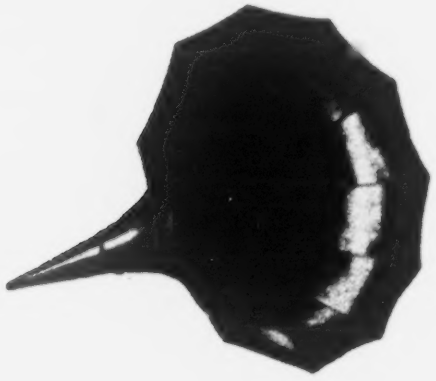
The parts comprising these attachments may be applied by anyone. When a Concert Phonograph is converted by one of the attachments it becomes equal to a Triumph in quality.

Edison Blanks

Shaved Standard Blanks	20 cents each
Concert Blanks, shaved and boxed	50 cents each

When sold by dealers, Edison Blanks are fully prepared for making Records. They may be shaved many times and used over and over for new impressions.

To be able to make Records at home is one of the enjoyable features of an Edison Phonograph. The best results are secured when Edison Blank Cylinders are used. These are of superior quality.



Edison Straight Horns

8 Petals, for Gem and Fireside, maroon finish	$1.75
10 Petals, for Standard, blue japanned with chrysanthemum decorations	2.75

Horn Cranes

For Gem and Fireside Phonographs	$0.25
For Standard, Home, Triumph and Alva Phonographs	1.25

Edison Wood Cygnet Horns

One size only, bell 21½ inches in diameter

Oak or Mahogany	$15.00
Spruce (to order only)	20.00
Inlaid Pearl (to order only)	50.00

Can be used on all Edison Phonographs but the Gem.

Above prices do not include horn crane, connections, etc. These are sold as follows:

For Phonographs now equipped with Cygnet horn (set includes a new swivel rod, suspension spring adjusting screw and horn connection). For Fireside, Standard, Home and Triumph . $0.75

For Phonograph equipped with straight horn (set includes a crane complete, suspension spring, adjusting screw and horn connection). Cranes, Nickeled $2.50

Edison Cygnet Horns

Including Horn, Crane and Horn Connections

Black Japanned with Gold Stripes

No. 10. For Fireside, Standard and Home Phonographs	$7.50
No. 11. For Triumph and Alva Phonographs	8.00

Oak or Mahogany Finish

No. 10. For Fireside, Standard and Home Phonographs	$12.50
No. 11. For Triumph and Alva Phonographs	13.00

Cygnet Horn Cranes

For Fireside, Standard, Home, Triumph and Alva Phonographs, $2.15

Hearing Tubes

Single	$0.50	Three-Way	$1.50
Two-Way	1.00	Four-Way	2.00

Hearing tubes are made of rubber and have hard rubber ear tips. They may be used instead of a horn when the operator wants to hear the reproduction without the volume of sound incident to the use of a horn.

Hearing Tube Rails

Six-Way with Tubes and Flexible Connection	$5.80
Ten-Way with Tubes and Flexible Connection	7.40
Fourteen-Way with Tubes and Flexible Connection	9.20
Seventeen-Way with Tubes and Flexible Connection	10.35

Rails are used in the same way as hearing tubes, except that from six to seventeen persons may listen at one time.

416

PLAINTIFFS' EXHIBIT NO. 44.

M. D. PENN.
COMPL. EX. 44

A NEW RECORDER FOR VARIABLE AREA RECORDING

EDWARD W. KELLOGG*

A recorder embodying certain new principles in its design and operation has recently been adopted by RCA Photophone, Inc. It is designated as Type PR-4. The optical system has been redesigned and a number of improvements made, especially in the direction of providing better facilities for adjustment. The sound record produced is of the variable area type which has been used from the beginning by this company, and which has given excellent results. It is, however, in the means employed for providing uniform movement of the film past the point where the recording is done, that the new recorder differs most radically from its predecessors.

Inherent Fault in Sprocket Drive.—It is recognized by engineers who have analyzed the question carefully that a sprocket, however perfectly formed, rotating at uniform speed, can in general impart to the film only an approximation to uniform speed. In spite of the accuracy with which the film perforating is done, the subsequent shrinkage of the film results in variations in length, and a sprocket which just fits one film will not fit the next. Fig. 1 shows what is meant here by "fitting." When the film is pulled snugly around the sprocket, the angular pitch of the sprocket perforations and teeth are exactly the same, so that all of the teeth engaged are in contact ready to contribute their shares of the total pull. Under these conditions, the sprocket can, theoretically at least, impart uniform motion to the film. No slippage takes place when the forward tooth disengages and a new tooth enters, and the speed of the film is just what it would be if there were no teeth but only a smooth drum of the same diameter with no slipping of the film.

Fig. 2 illustrates the relation between perforations and teeth when the film is shorter than a fit. It will be noticed that the last tooth toward the slack side is the only one that can exert any pull, since the others do not touch either edge of their perforations. Fig. 2 might

*RCA Victor Co., Inc., Camden, N. J. (Read before the Society at Washington.)

represent either a pulling sprocket with counter clockwise rotation or a hold-backs procket with clockwise rotation. Let us consider the case of a pulling sprocket. So long as the film is against the bottom of tooth No. 1, no other tooth being in contact with film, there will be no slipping over the cylindrical supporting surface, and the film will move at the non-slip speed, $V = \pi(D + t)n$, in which D is the diameter of the cylindrical supporting surface, t the thickness of the film, and n the number of revolutions per second. When tooth No. 1 reaches the end of the arc of wrap and the film begins to strip from No. 1, it must slip back by the amounts by which tooth No. 2 previousy failed to touch, before No. 2 can exert any pull. After this slip-back has occurred and tooth No. 2 is in contact, the film speed

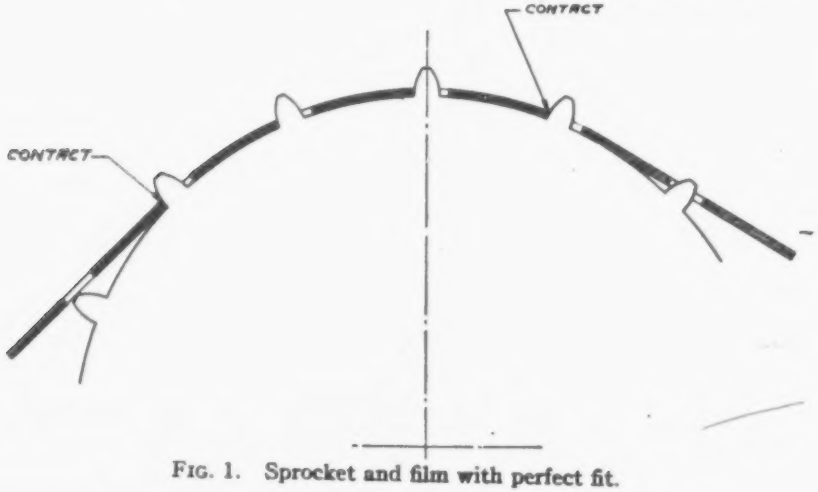


FIG. 1. Sprocket and film with perfect fit.

resumes the non-slip value until No. 2 begins to strip. The film motion thus consists of a series of movements at non-slip speed, alternated with movements at lower speed during which the slip-back is taking place.

What the speed of the film is during slip-back and what fraction of the time the slipping back occupies, depends on the shape of the teeth and the manner in which the stripping takes place. The ideal stripping would be for the film at a certain point to cease following the arc and follow a tangent. Tooth roughness would cause inevitable departures from the manner of stripping just described, with consequent irregularities in the film velocity, but only by assuming that the film moves outward from the sprocket at some definite rate can

we figure the rate of slip-back in terms of tooth shape. If the tooth surface were a circular involute no slip-back could occur while the film is sliding up along the tooth surface, and the inevitable readjustment would take place when the film is actually clear of the tooth, at which time a jump-back would occur. The tooth should evidently be cut back—more taper than an involute—so as to permit the film to slip back continuously while the stripping is taking place. Two suppositions may be considered, (1) that the tooth is so cut that the rate of slip-back is not constant, for example, that the slipping back is slow at first and more rapid later, and (2) that the tooth is cut to give a constant rate of slip-back. The first design obviously gives a net film speed which is not constant, although the departure from

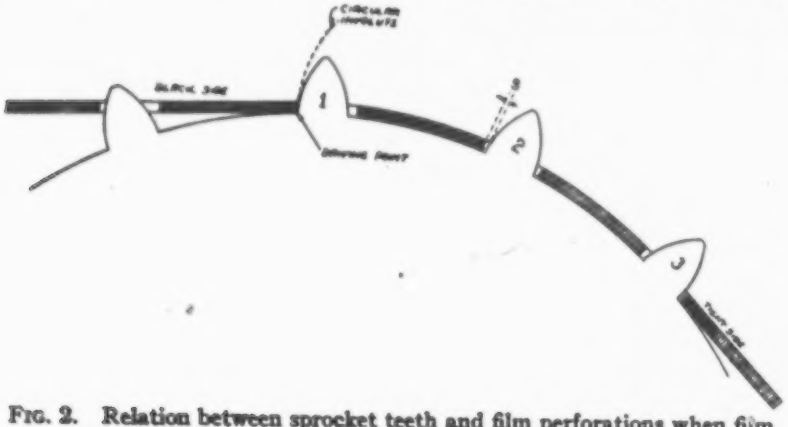


FIG. 2. Relation between sprocket teeth and film perforations when film is short.

constancy may with good design be small. If the tooth is so cut that with stripping of the kind mentioned above, the slip-back is at a constant rate, then there are three analyzable cases to consider. (1) The film slips back sufficiently to touch the bottom of tooth No. 2 before it begins to strip from No. 2, or, in other words, before it pulls away from the cylindrical surface at the bottom of tooth No. 2. (2) The film slips back sufficiently to touch the bottom of tooth No. 2 just as the stripping from No. 2 begins, and (3) the film does not slip back sufficiently to touch No. 2 when stripping from No. 2 begins. These three cases might arise from use of different tooth pitch and shape with a film of given perforation spacing, or with a given sprocket they correspond to three different degrees of film shrinkage.

In case (1), the film moves at non-slip speed so long as it remains

against the bottom of the tooth. Thus there are two film speeds, one during the interval that the film is being stripped from the pulling tooth, and another while it is resting against the bottom of the next tooth. In case (2) the latter period is zero. The film is at all times undergoing stripping from the tooth which is doing the pulling. We have assumed that the tooth surfaces are so designed that during stripping there is a constant rate of slipping back. Therefore, with case (2) the film progresses at a constant speed, namely, the slip-back speed.

In case (3), the film fails to engage tooth No. 2 at all until it has been slipped off the end of No. 1. The case is similar in this respect to that where the tooth was shaped as a circular involute.* Despite the fact that the tooth has been cut back to permit a certain uniform rate of slip-back as the film slides up the tooth, the slip-back speed is not as slow as a film of this shrinkage requires, and an additional jump-back occurs as each tooth in turn is cleared. The jump-back may occur before the second tooth begins to strip, or afterward. In the latter case, the surface of the second tooth recedes just fast enough to stay clear, until the first tooth disengages.

We have found, then, two conditions which can give, at least on paper, constant film speed. In one, the film fits perfectly and there is no slipping, and with the second condition the film is always slipping back at a rate determined by the tooth shape. But out of the infinite gradation of possible film sizes or degrees of shrinkage there are two specific sizes that meet these requirements, and their probability of occurrence is exactly two divided by infinity or zero. We may say then that from a purely theoretical standpoint, in view of the variations in size of the films to be handled, a sprocket rotating at uniform speed will not produce uniform motion of the film. In practice, the performance will inevitably be poorer than that predicted by a theoretical analysis based on ideal conditions or, in other words, on the assumption of perfect workmanship. The use of a flywheel on the sprocket shaft or of mechanical filtering, while it may eliminate speed irregularities due to imperfections in the driving system, can go no farther than to rotate the sprocket uniformly which is the condition assumed for the discussion. The irregular motion of the film due to tooth action remains.

The analysis need not be repeated for the cases so far not covered, *i. e.*, film too long instead of too short and hold-back sprockets instead of pulling sprockets. The actions that take place are similar but may

occur at a different point. For example, in the case of the pulling sprocket with over length film the tooth next the tight side does the pulling, and the slipping occurs during engagement instead of during stripping.

To show that a sprocket cannot, even under ideal conditions, impart perfectly uniform motion to a film, does not dispose of it as a practical means of driving the film in making a sound record. The question is rather how great are the variations in speed and how detrimental is their effect on the quality of reproduced sounds. The magnitude of the variations in speed is difficult to estimate, but the total phase shift produced by the readjustment when a new tooth comes into engagement cannot exceed a certain value. In the case of a recorder, the variations in film length probably do not exceed one-half of one per cent. If the film on which the record is being made deviates by one-half of one per cent from the length which would just fit the sprocket, then the readjustment would be of the order of one mil, since the perforation pitch is nearly 200 mils. One mil is a quarter wave-length at 4500 cycles, a twelfth of a wave-length or 30 electrical degrees at 1500 cycles, 10 degrees at 500 cycles. A recurrent break in continuity, occurring as this does 96 times per second, produces a modulation or fluttering of the tone if the cycle of speed change is regular, while the effect dwindles to a general roughening of the tone if the readjustments are small or irregular. This roughening of the tone, when it does not produce an actual flutter or "gurgle," gives an impression very similar to added ground noise. The tooth flutter characteristic is most noticeable with high pitched tones especially if the tones are smooth to start with. The effect is least when the sound recorded is general noise, speech, or music with complicated wave forms such as choral, band, or orchestra music. Rapid tempo also makes speed fluctuations less noticeable. While there are many classes of recording in which tooth flutter or "gurgle" is difficult to recognize even though present, there can be no question that some loss of quality is practically always involved, and on the principle that the best we know how to do is none too good, the engineers, who have taken part in the development of the Photophone system, have from the start attempted to minimize speed irregularities. This is especially true of recorders where the cost of refinements can be justified in view of the small number of machines involved.

Means of Obtaining Uniform Motion.—A toothless drum is the

logical substitute for the sprocket when the steadiest speed possible is sought, and it is obvious that the drum must be true (not eccentric) and must itself rotate at constant speed, and, furthermore, the film must not slip on the drum. The first of these conditions calls simply for good machine work. A flywheel is the classical and unexcelled means of obtaining uniform rotation. The elimination of slipping depends on avoiding excessive tension on the film, the use of a drum surface which is not highly polished, and the maintenance of good contact pressure. The most satisfactory way of producing the desired normal pressure is to employ one or two soft tired pressure rollers bearing against the film.

Securing Correct Drum Speed.—A machine for recording synchronized sound must of course have sprockets, since it is the number of sprocket holes passing per second, and not the linear feet of film which must be the same in two synchronized films. The sprocket speed being fixed, the drum speed must be altered in accordance with the degree of film shrinkage. The drum can therefore not be positively driven, either by gears, belt, or friction drive, unless provision is made for altering the ratio of drum to sprocket speeds in a continuously variable manner and subject to automatic control by the film itself. If the drum is positively driven at a speed which is not exactly correct, the slack will disappear from one or the other of the film loops preceding or following the drum, and the film will get tighter until (if the film does not tear) sufficient slippage occurs over the drum to make up for the error in drum speed; and when this condition of slipping obtains, the drum is no longer of any assistance toward obtaining uniform speed.

The simplest method of driving the drum at the right speed is to let the film, acting as a belt, supply the power to rotate the drum. This system was employed in the pioneer work of Mr. C. A. Hoxie of the General Electric Co., and was later applied to some of the commercial recorders. A recorder employing a variable speed friction drive was developed by Mr. C. L. Heisler of the General Electric Co. The speed of the drum was governed by the length of a loop of film between the drum and one of the sprockets. An idler roller mounted on an arm, with a counterweight, served to measure the length of the film loop, and the position of the arm controlled the position of one of the friction rollers. Both of these machines when in proper condition gave excellent results. Mr. Hoxie also worked out a system with positively driven drum based on an entirely different principle,

and Mr. Heisler has employed an all-geared system in both recording and reproducing machines.

Experiments with Magnetic Drives.—The PR-4 recorder had its origin in a laboratory model shown in Fig. 3 built several years ago under the writer's direction in the General Electric Research Laboratory. In this model effort was made to obviate some of the difficulties which had appeared in the machines in which a drum was driven by the film. In machines of the type just mentioned it had been found that increasing flywheel size was helpful up to a certain point, but beyond this there was no gain. The most plausible explanation

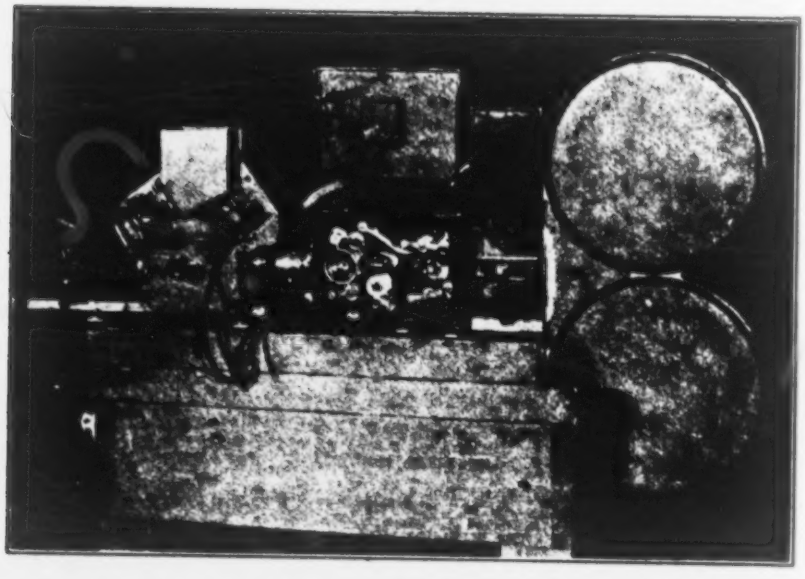


FIG. 3. Original model of PR-4 type recorder.

appeared to be that the heavier the flywheel, the more bearing friction was introduced, and the required traction became so high that slippage of the film over the drum occurred. The simple film-pulled drum system was subject to another fault, particularly when the traction was good. A slight irregularity in the speed of the sprocket would accelerate the drum to a speed slightly above normal, so that the tension on the film eased up. Since the drum was not now receiving enough power, it slowed down until the film was tight again, and a strong jerk occurred which again raised the speed above normal. A condition analogous to "hunting" of synchronous machines thus

occurred, although instead of having a definite natural period the drum might be described as bouncing along. This action was not always apparent, and if the gearing was accurate it was largely eliminated.

In the laboratory machine just referred to, an auxiliary drive of the drum was provided which served both to reduce the traction required from the film, and to damp out any hunting which might occur. A copper flange was attached to the flywheel and a multi-pole electromagnet on a concentric shaft exerted a drag by inducing eddy currents in the copper flange. The magnet was driven through gears about 20 per cent faster than the normal drum speed, and therefore exerted a forward torque, which could be made to just supply the friction losses, thus relieving the film of all strain.

Prevention of Hunting.—The torque applied to the flywheel flange by such a magnetic drive is directly proportional to the relative velocity. Herein lies its potency in damping out oscillations. When the flywheel is running above average speed it receives less assistance from the auxiliary drive, and when it is below average speed it receives more. This amounts to superimposing upon the steady torque supplied by the magnet, an alternating torque, in phase with and opposing the motion of any oscillation which may be superimposed on the steady motion of the flywheel. Such a transient oscillation occurs, for example, when the machine is first started. The excess torque required for acceleration is supplied largely by the film, the tension being limited by the pressure with which the film is held against the drum. After the drum has reached normal speed it must run over speed for a moment in order to throw enough slack film into the lower loop to relieve the film of tension. It tends to continue over speed until the upper loop has lost its slack and begins to pull back. Such an alternation of over and under speed may continue through a good many cycles unless means of damping such as have been described are provided. With the magnetic drive the starting transient has spent itself and the drum reached steady speed within four or five seconds from the time of starting the motor.

Were the auxiliary drive of such a nature that the torque supplied was independent of relative speed, for example, if it depended on rubbing friction, it would serve to relieve the film of some of its tension but its damping effect would be nil. An auxiliary drive depending on viscosity of a film of oil would undoubedly work satisfactorily, but

the magnetic drive has the advantages of ease of control, practical independence of temperature, and nothing to leak or spill.

Magnets Not a Source of Irregularity.—It might appear that the magnetic drive would itself produce speed irregularities, if the magnet is not driven at perfectly constant speed. It is easy to show by a rough calculation that reasonably good gears will reduce drum speed fluctuations from this cause to negligible magnitude. The slowest running gear in the train makes about three revolutions per second. Let us suppose for illustration that this gear is so eccentric that for a half revolution or a sixth second the magnet runs one per cent over speed while for the next sixth second it runs one per cent slow. Since the average slip is 20 per cent of drum speed, a one per cent change in magnet speed corresponds to a six per cent change in slip and therefore in the torque supplied to the flywheel. A well run-in flywheel takes about 30 seconds to come to rest from full speed when retarded by friction alone. The speed loss the first second will be a little greater than $^1/_{30}$, say, $^1/_{20}$ of full speed. Since the magnet torque is about equal to friction, a 6 per cent change in slip would cause the flywheel to change speed at the rate of $0.06 \times {}^1/_{20}$ of normal speed per second, and a sixth as much or $0.01 \times {}^1/_{20}$ in a sixth of a second. This total change in flywheel speed, which takes place while the magnet is running at, say, one per cent excess speed, carries the flywheel from its minimum to its maximum speed, so the net deviation from average speed would be $^1/_{40}$ of one per cent, as a result of an inconceivably bad gear.

Other Measures to Insure Good Operation.—In the original laboratory model, effort was made to stop all the leaks by which speed irregularities might creep in. The general arrangement is shown diagrammatically in Fig. 4. An extra sprocket was provided to relieve the sprocket next the drum from film jerks originating in the magazines. A flexibly mounted idler roller with dashpot attached was interposed in the film loop by which the drum was pulled, it being contemplated that the magnets would supply 80 to 90 per cent of the driving torque and the film the remainder. Two rubber tired pressure rollers were provided to hold the film in contact with the drum. In order that the film between might stay tight against the drum a retarding drag was provided at the upper or feed-on roller, and a forward drag applied to the lower roller. The power for the latter was obtained from the former through a friction drive connection between the two, and a smooth acting slipping device was interposed between

the one roller and the intermediate rollers to take up the slip. If the tire had been removed from the lower roller so that it was clear of the drum it would have run about 10 per cent over speed. When in contact with the film the lower roller exerted a slight forward pull tending to stroke the film down onto the drum.

Tests indicated that in future designs all three of the foregoing expedients might be omitted. The extra sprocket was superfluous. The flexibly mounted idler came into play during starting and by reason of the dashpot, made the starting transient more "dead beat," shortening the time required to reach steady speed by a second or so, but once the machine was up to speed, the rocker that carried this idler was motionless, showing that it contributed nothing to the steady running of the drum. It was also found that the film stayed snugly against the drum whether the lower pressure roller was driven through the friction coupling or not. Film tension is the chief factor relied upon to keep the film against the drum, but evidently when the rollers are acting properly, a very slight tension suffices. The first films made with the laboratory model recorder proved at least equal to and perhaps better than the best records made on other available machines. Having no perfect reproducing machine it was impossible to test a recorder, and having no perfect recorder it was impossible to test reproducing machines. Not until the same machine was adapted for reproduction could its performance be fairly judged. The probability of speed variations in reproduction neutralizing the effect of the same variations during recording is extremely remote, and would not occur in two successive playings of a given record.

The Steady Tone Test.—The test for speed constancy which we have found most satisfactory consists in making a record by means of an oscillator, preferably of a series of tones from about 500 to 3000 or 4000 cycles, and then listening to the reproduction of the record using a loud speaker in a fairly large room in which strong standing waves are produced. This is about the severest test for speed constancy to which a recorder or reproducer can very well be subjected. Small recurring variations in speed cause marked pulsations in the loudness of the tone, which we have come to call "Wow wows." Nothing which the ear detects as a change of *pitch* occurs unless the irregularities are extremely bad.

An idea of the sensitiveness of this method of judging speed fluctuations may be gathered from a test made several years ago in the Fifth Avenue Studio of RCA Photophone, Inc., by Mr. L. E. Clark (now

of Pathé Studios, Culver City, Cal.) in which he fed a loud speaker from a beat frequency oscillator with a tone that rose in frequency at a measured rate, and recorded the tone using a microphone about 15 feet away. Examination of the resulting record showed that two to one variations in amplitude resulted from frequency changes of less than one-tenth of one per cent. This is not surprising if we consider the manner of formation of the interference pattern in the room. Many of the wave trains passing the microphone have crossed the room several times and are compounding with waves that have traveled only a short distance. As a simple case, consider a train of plane waves of 3200 cycles reflected from a wall, and the pressure measured by a microphone at a point twenty feet from the wall. The wave-length would be about four inches, or there would be sixty wave-lengths between the microphone and the wall. A change in frequency sufficient to make this $60^1/_4$ wave-lengths would cause the microphone to be at a pressure node instead of a pressure loop, which represents a very large relative change in pressure for a change in frequency of one part in 240.

Various other means of testing speed constancy have been tried, such as stroboscopes, and folding a film record back on itself. When we recall that a speed change of a fourth of one per cent lasting a tenth of a second, results in a shift of the wave from normal position of only 0.0045 inch, it is not strange that the blurred lines shown by a stroboscope do not reveal speed fluctuations of the kind we are considering. Folding a steady tone record film back on itself and noting where the waves coincide and where they are offset, has been useful in some instances as a test of constancy of the recorder, but this again depends on accumulated phase shift, and therefore is much less sensitive as an index of speed fluctuations having a rapid cycle of repetition, than of slow variations. On the other hand, the rapid fluctuations make more impression on the ear than slower variations involving the same range of speed; and undoubtedly the rapid fluctuations are more deleterious to musical quality. A slow beat, it should be recalled, is a part of the "voicing" of many musical instruments, but rapid beats mean an instrument out of tune. Next to steady tones the sounds most noticeably affected by speed irregularities are piano selections, in which high grade mellow toned pianos are changed to cheap "tin-panny" instruments in bad need of tuning.

One possible measure to secure constant speed was not employed, namely, refined workmanship. Commercial spur gears were used

throughout and no close tolerances were called for, beyond the requirements that the drum run true and run freely and that the flywheel be balanced.

Film Instability.—It should not be inferred that no "grief" was experienced with the first magnetic drive machine. The first film we tried to put through it ran off the end of the drum. Putting a single tire in the middle of the lower pressure roller instead of one at each end seemed to help slightly, but still the film was unstable. Adjustments of pressure and tension had only small effect. Finally Mr. C. W. Rice made the apparently absurd suggestion that the guide flange on the roller marked "*A*" in Fig. 4 be removed. It worked.

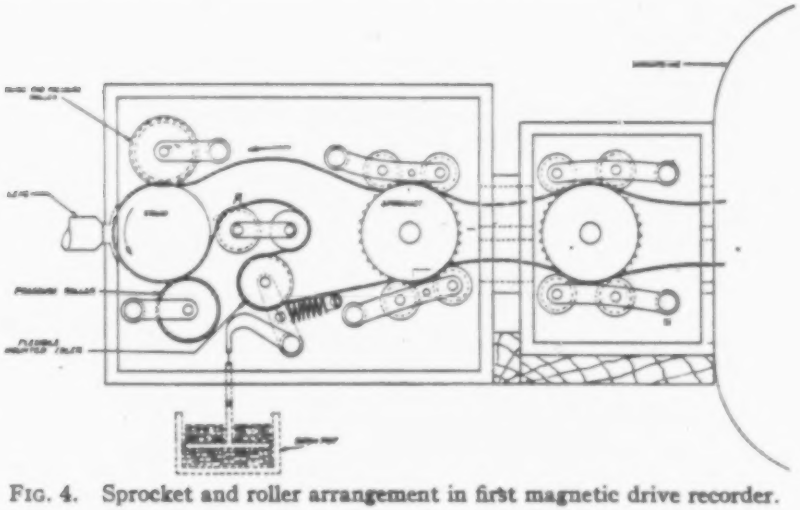


FIG. 4. Sprocket and roller arrangement in first magnetic drive recorder.

Thereafter the instability quite disappeared. There remained a slight sidewise weaving, due to the fact that the film was not sufficiently positively steered as it entered between the flanges of the combination pressure and guide roller above the drum. A change which gave the film a substantial wrap around the guide roller cured this difficulty.

The theory of the instability just mentioned is interesting. It is a factor which must be taken into account whenever a film is pinched between two rollers. As a simple case, consider a film guided at *A*, Fig. 5, running between a pair of rollers at *B* and guided again at *C*. So long as it is not displaced sidewise at *B* nothing happens, just as a balanced stick does not begin to fall if it is exactly vertical. Next suppose that the film is displaced, as shown in Fig. 6, being straight

from B to C, and the kink occurring between A and B. The rollers at B do not encourage the film to move parallel to its center line but rather force it to move perpendicular to their own axes. Thus, if d_1 is the point now central with respect to the rollers, the next parts of the film to occupy this position will be d_2, d_3, d_4, successively, each farther from the center line of the film, so that the film is rapidly pushed off to one side. If, on the other hand, the film is tight from A to B and the kink occurs between B and C, it will be stable, for, as

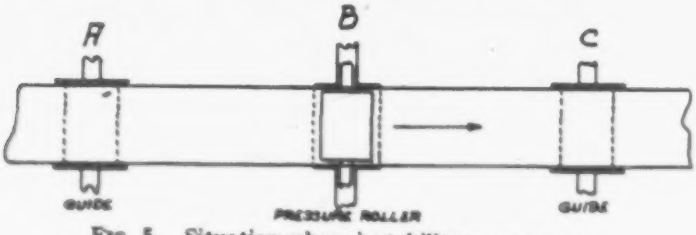


FIG. 5. Situation where instability may appear.

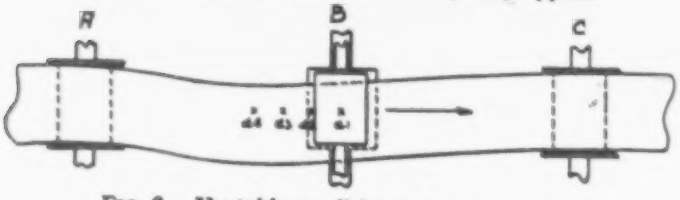


FIG. 6. Unstable condition at pressure roller.

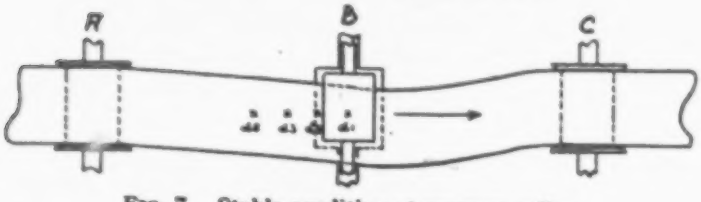


FIG. 7. Stable condition at pressure roller.

shown in Fig. 7, if the film is displaced, the parts of the film d_1, d_2, d_3, d_4 to reach the center of the rollers are successively closer to the center of the film.

Two ways of preventing such instability are now evident. (1) Provide positive guiding at B, or (2) make it easier for the kink to occur between B and C than between A and B. The second plan means making the film as stiff as possible between A and B, and flexible with respect to taking up edgewise displacements between B and C. The desired stiffness is helped by making the span short and

straight or supported, and having considerable tension, while the flexibility is helped by low tension, a long span, and by carrying the film around bends. The desirability of low film tension on the feed-off side of the pressure rollers suggests the advisability of over driving rather than under driving the drum, and this feature has been incorporated in the commercial design.

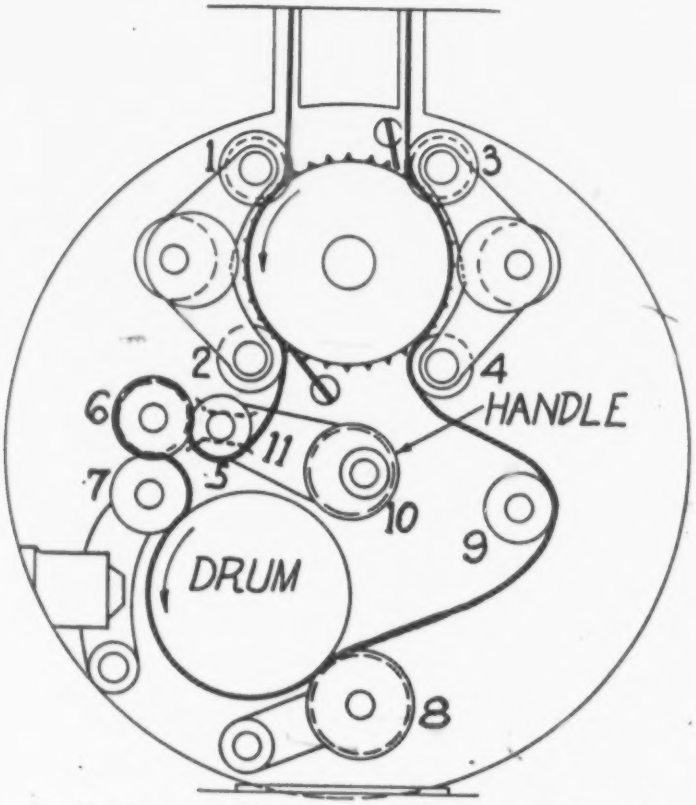


FIG. 8. Sprocket and roller arrangement for PR-4 recorder.

Design of Commercial Model.—The design of the commercial model was worked out by Mr. G. M. Jones and Mr. D. G. Tilton, to whom are due the elements of convenience, rugged and workmanlike construction, and neat appearance. All questions involving changes which might influence performance were carefully checked experimentally by Mr. Tilton, and the samples so far tested have given performance at least equal to and probably slightly better than the original. The

general arrangement is shown in Fig. 8. Rollers, 1, 2, 3, and 4, are sprocket pad rollers. No. 5 serves to give a large wrap around the guide roller, 6. It can be moved clear of the guide roller for threading, by means of the handle, 10, which turns an eccentric and slides the carriage, 11, to the right. No. 8 is a rubber tired pressure roller.

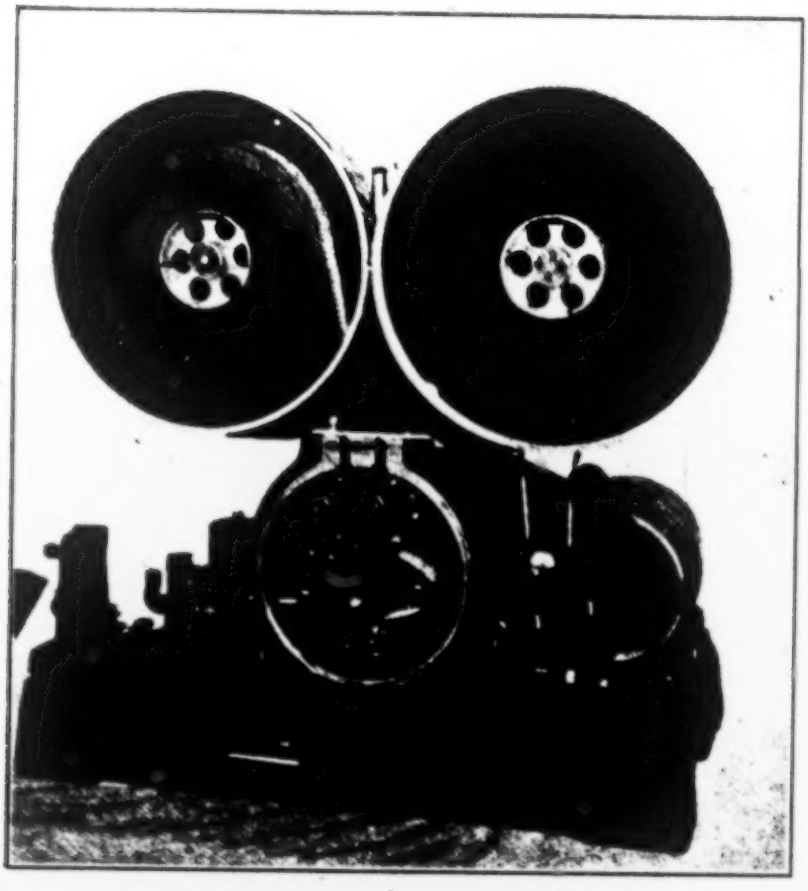


FIG. 9. Type PR-4 recorder.

No. 7 was originally intended as a pressure roller, but Mr. Tilton found that it worked as well when just failing to press the film against the drum, so a solid metal roller, clearing the drum by about $^1/_{32}$ in., is used here instead of a rubber tired pressure roller. The purpose of roller No. 9 is to cause the loop to take such a shape that the film is under slight tension where it issues from between the drum and the

pressure roller, 8. If the pressure roller is dropped the film will still stay against the drum, and this condition, it was felt, would be favorable to the film always staying snugly against the drum when the roller, 8, is in contact. By way of comparison, notice the shape of the upper film loop in Fig. 4. With a loop of this shape the film is under slight longitudinal compression and would tend to jump away from the drum if the pressure roller were raised.

The excess magnet speed has been reduced in the new design to

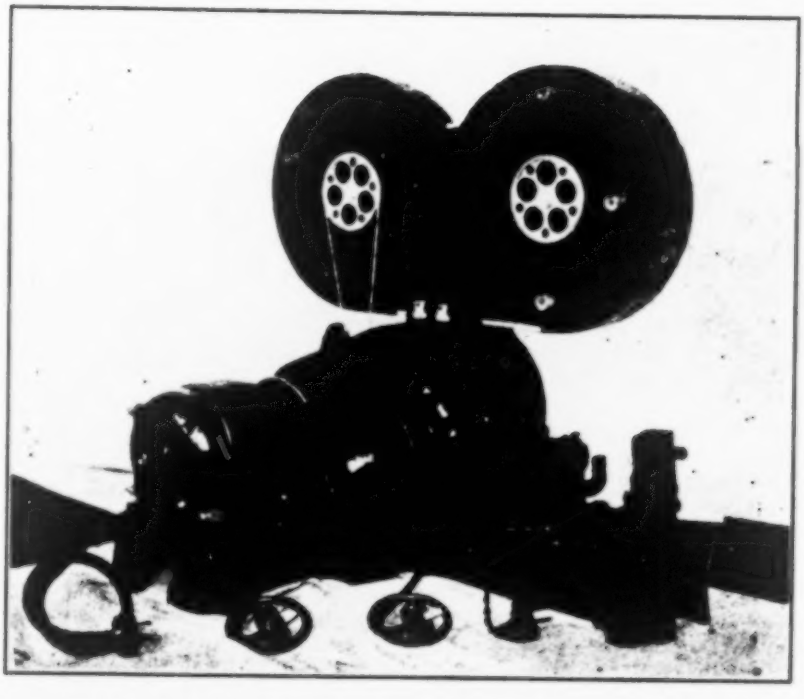


FIG. 10. Recorder from rear showing auxiliary magnetic drive.

15 per cent. This results in a stronger damping action for the same average torque supplied. On the other hand, more possibility of the magnetic drive itself introducing speed fluctuations is brought about by working with lower slip, but we have seen that this is not a real danger.

Adjustment of Magnet Current.—It has been usual to adjust the magnet current by running an exposed film through the machine and judging when the best value is reached from the appearance of the

film loops. It is found that there is a considerable range of current within which both loops are definitely loops and not straight tangents from one roller to the other, and that records made with the magnet current within this range are about equally good. Normal operation is with the drum slightly over driven by the magnets, or, in other words, with the slack mostly in the lower loop and the film in the upper loop pulling back slightly. This condition is favorable to satisfactory guiding, and since the only pressure roller is the one below the drum, the slight tension in the upper loop is needed to insure that the film will stay snugly against the drum. As an illustration of the range of satisfactory operation, it was found in one machine tested that $1^1/_4$ amperes were required to throw the slack into the

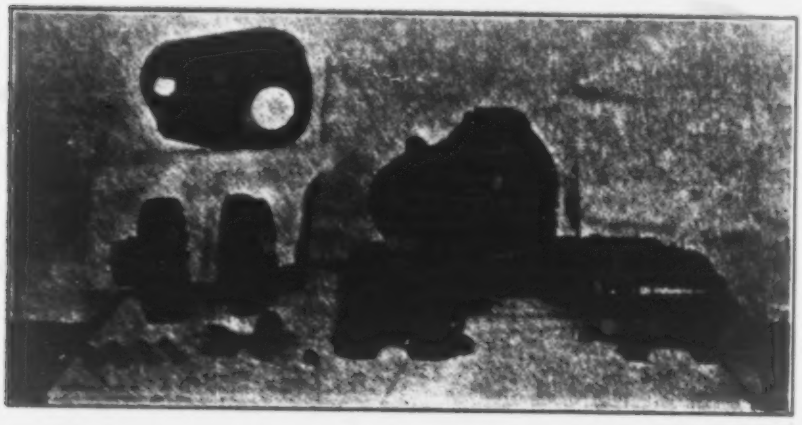


FIG. 11. Recorder disassembled.

lower loop, and that operation was satisfactory up to $1^3/_4$ amperes. With higher currents a slight tremolo appeared in steady tones recorded.

The wide latitude possible in magnet current setting, and the fact that steady motion of the film is not dependent on refinements in gear construction, are believed to augur well for consistently satisfactory results with the new machine.

The recorder imposes a very light load on its driving motor (about ten watts motor output), a favorable factor especially in case Selsyn motor drive is wanted.

The existence of slack film loops on either side of the drum might lead to the inference that there would be sufficient variation in the

amount of film between the sprocket and recording point to cause uncertainty in regard to synchronism. Under actual running conditions the difference between a very loose upper loop and a tight one is not more than 1/8 inch, which is less than the variations in threading between two sprockets in a machine having several driven sprockets. The amount of slack in the lower loop seems to have no effect on the operation of the machine, from 1/8 inch to 1/2 inch being satisfactory.

Fig. 9 shows the PR-4 recorder with door open and film in place. A rear view, Fig. 10, gives an idea of the magnet construction. In Fig. 11 the machine is disassembled to show the simple gearing arrangement.

DISCUSSION

MR. RINGEL: It has been my experience with regard to variations in speed due to irregularities in sprocket drive of film in projectors, that such variations are more noticeable on high frequency sounds than on low frequencies. This is particularly true in the case of higher pitched tones of the violin and the soprano voice. The raspy effects resemble the sounds obtained from an overloaded amplifier tube so closely as to deceive an inexperienced listener as to the true source of the trouble; sprocket variations, however, give objectionable results principally on higher frequencies. About a year and a half ago, we checked the cause of the trouble in a projector in the following manner:

A variable area record was made of a 2000 cycle tone on one of the recorders described by Mr. Kellogg. Its freedom from non-uniform speed was verified by folding a strip of film 7 or 8 feet in length back on itself, and observing that every cycle of the overlapped film coincided with every cycle on the film below. This film was played in the projector under test and the electrical output applied to two terminals of a Wheatstone bridge arrangement, one of whose arms consisted of a series resonant circuit turned to 2000 cycles. The bridge was balanced so that this frequency would be eliminated from the opposite pair of terminals which was connected to the recorder and recorded on film. Examination of this new film revealed little groups of 2000 cycle waves occurring at sprocket intervals —with no modulation in the spaces between these groups, indicating that the pull on the sprocket holes was responsible for changes in speed of the film, with resultant changes in the frequency of the reproduced sound.

MR. E. D. COOK: In this recorder we have one of the most beautiful developments we have ever seen. The principle involved is unique since most of the energy used to move the film is supplied through the best filtering means designed so far. I refer to the induction drive. The small amount of additional energy necessary to maintain the machine at a speed consistent with the number of sprocket holes passed per second by the sprocket, is supplied through the film itself. Because the sprocket is isolated by a loop from the drum, that percentage is again reduced. I don't think I have ever seen a mechanical filter system more unique or more desirable.

PLAINTIFFS' EXHIBIT NO. 45.

United States Patent No. 1,891,387.

436

Dec. 20, 1932.

J. A. MAURER, JR

1,891,387

FILM PHONOGRAPH

Filed Oct. 28, 1931

3 Sheets-Sheet 1

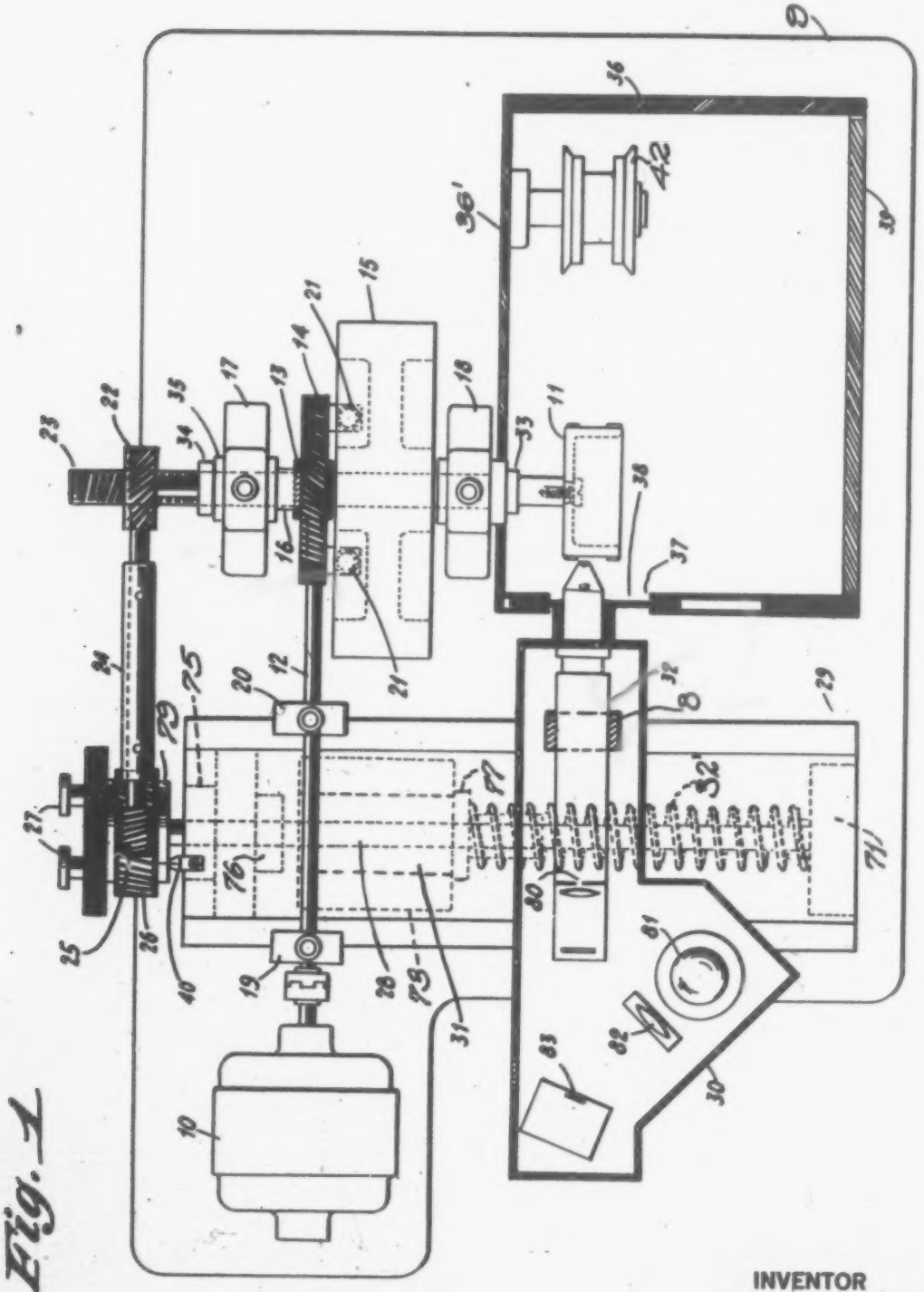


Fig. 1

INVENTOR
JOHN A. MAURER Jr.

J. A. MAURER, JR 1,891,387

FILM PHONOGRAPH

Filed Oct. 28, 1931 3 Sheets-Sheet 1

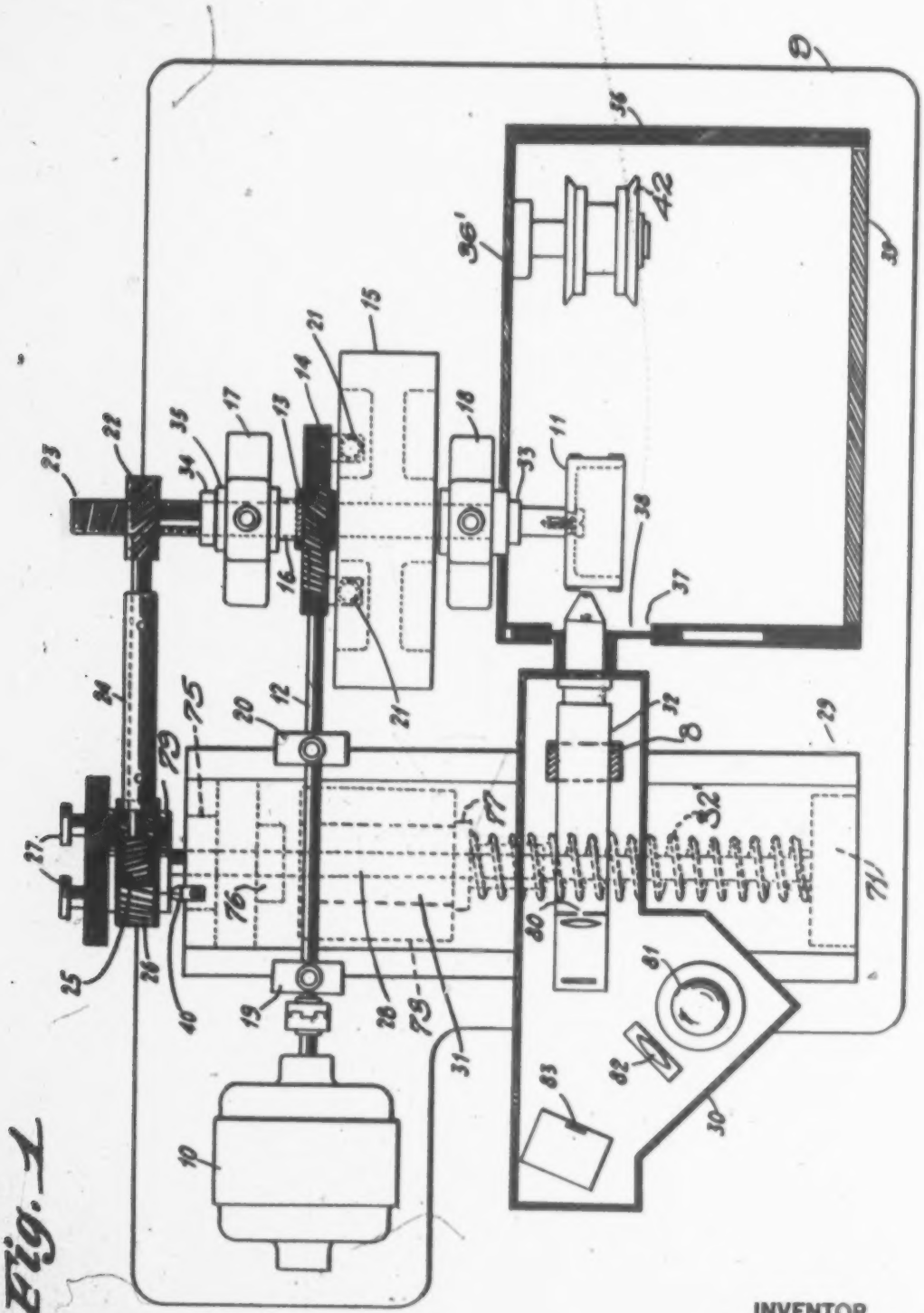


Fig. 1

INVENTOR
JOHN A. MAURER JR.
BY H. S. Grover
ATTORNEY

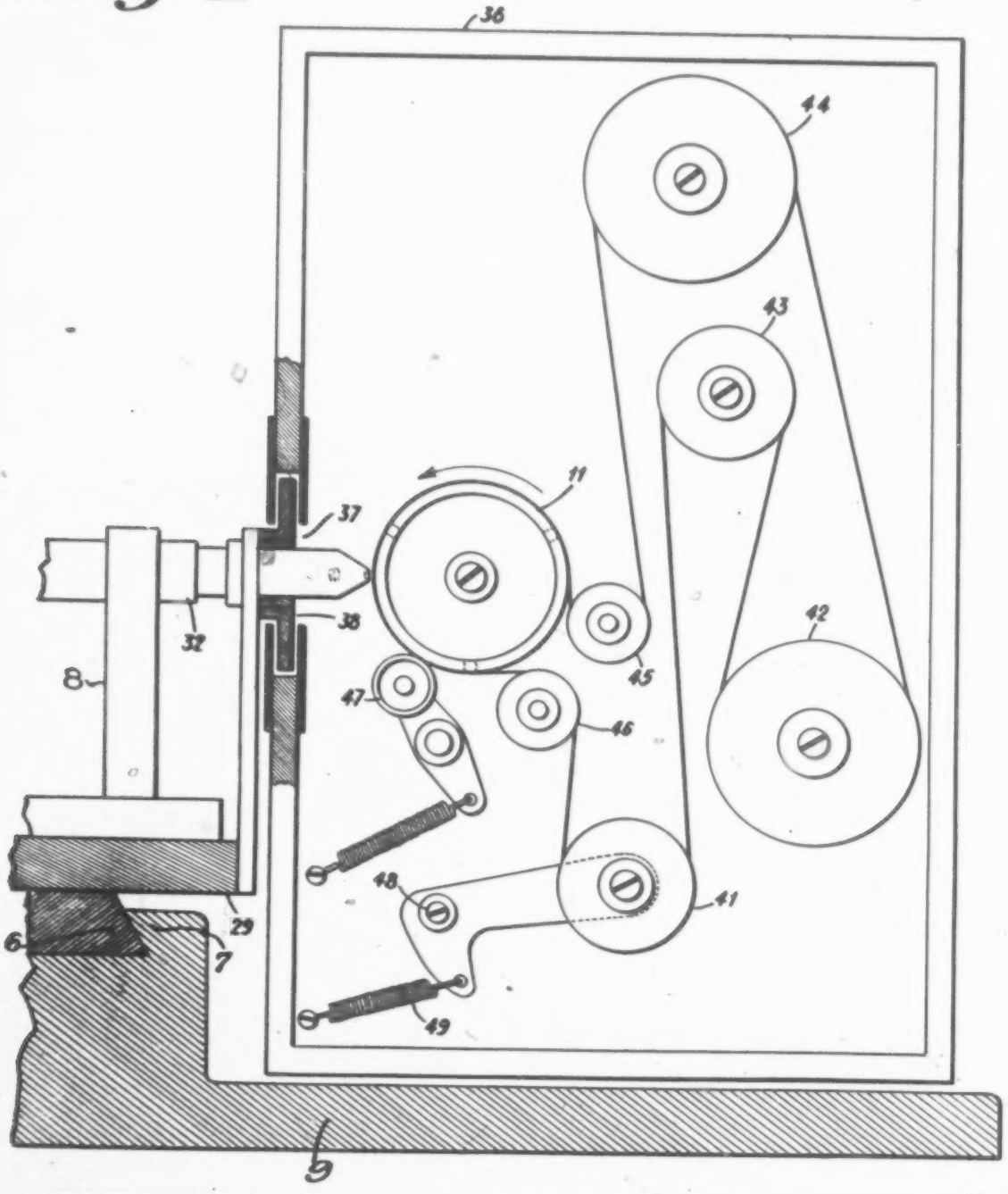
438

Dec. 20, 1932. J. A. MAURER, JR 1,891,387

FILM PHONOGRAPH

Filed Oct. 28, 1931 3 Sheets-Sheet 2

Fig. 2



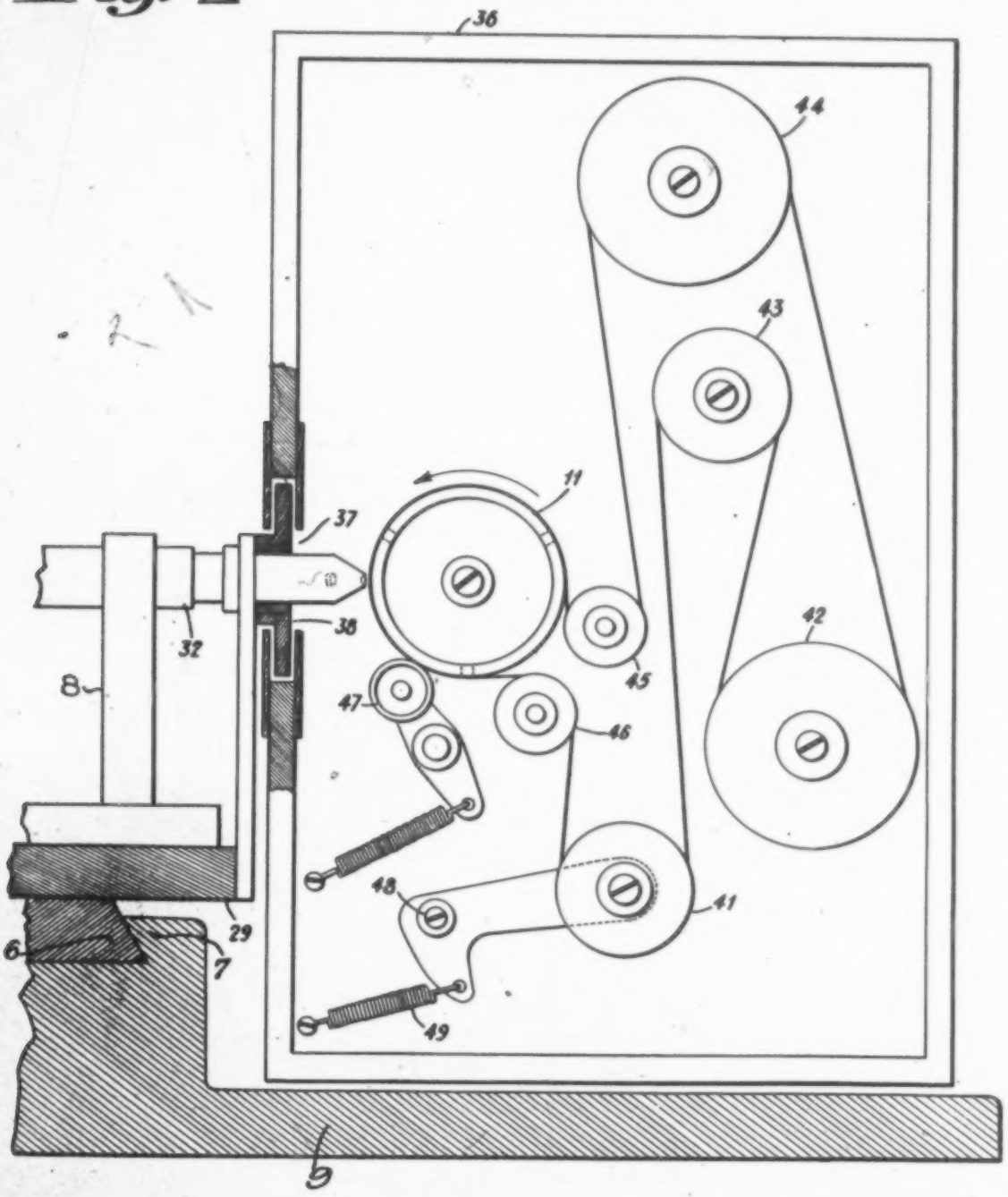
INVENTOR
JOHN A. MAURER Jr.
BY

Dec. 20, 1932. J. A. MAURER, JR 1,891,387

FILM PHONOGRAPH

Filed Oct. 28, 1931 3 Sheets-Sheet 2

Fig. 2



INVENTOR
JOHN A. MAURER Jr.
BY H. S. Grover
ATTORNEY

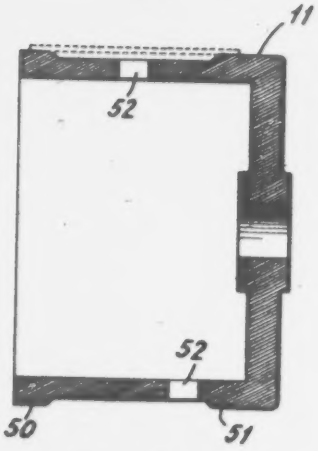
440

Dec. 20, 1932. J. A. MAURER, JR 1,891,387

FILM PHONOGRAPH

Filed Oct. 28, 1931 3 Sheets-Sheet 3

Fig. 3



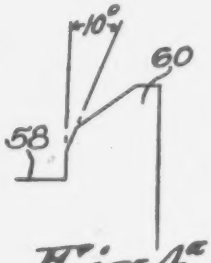


Fig. 4a

Fig. 5

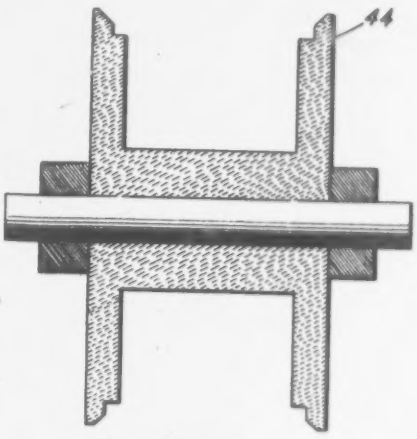


Fig. 4

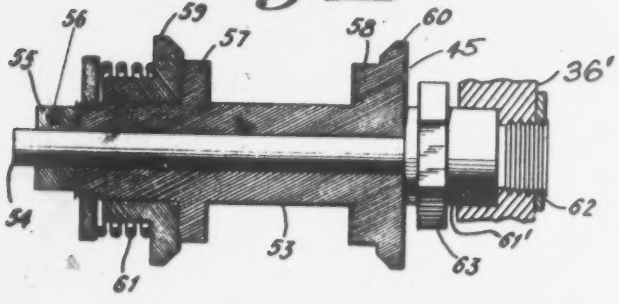


Fig. 6

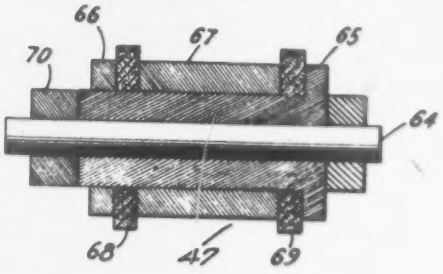


Fig. 7

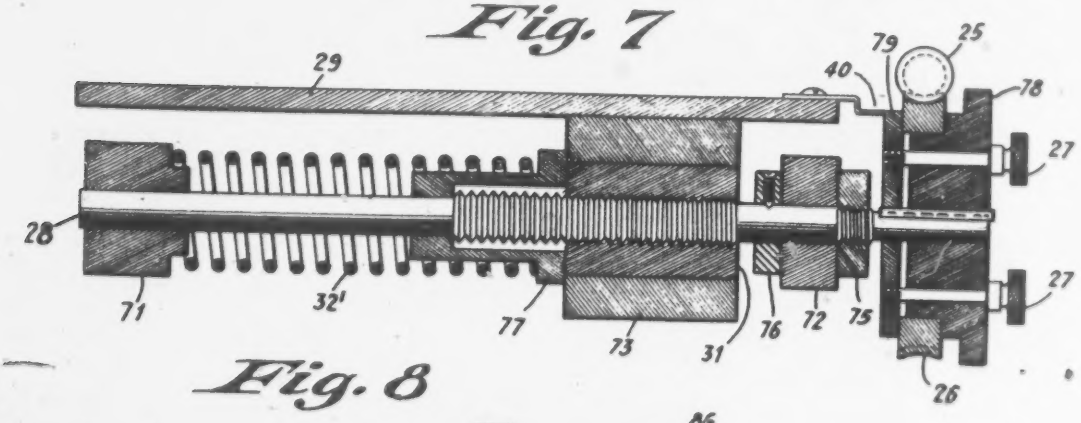
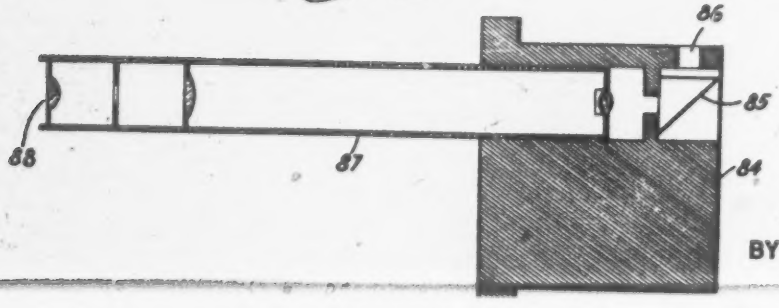


Fig. 8



INVENTOR
JOHN A. MAURER JR.
BY H. G. Grover

Patented Dec. 20, 1932

1,891,387

UNITED STATES PATENT OFFICE

JOHN A. MAURER, JR., OF NEW YORK, N. Y., ASSIGNOR TO RADIO CORPORATION OF AMERICA, A CORPORATION OF DELAWARE

FILM PHONOGRAPH

Application filed October 28, 1931. Serial No. 571,532.

This invention relates to the recording of sound and has for its principal object the provision of an improved sound recorder suitable for the production of sound records of the micro-photographic type. While specific data on the construction of a practical form of the apparatus are given, it will be apparent that the invention is not limited to this particular form.

The particular recorder herein described is designed to produce a photographic sound record in the form of a helix on a continuous loop or belt of film. The dimensions of the record track are almost microscopic; that is, of a width of the order of two thousandths of an inch. The spacing from center to center of the adjacent turns of the helical sound track is of the order of four thousandths of an inch.

In the recording of sound the film is driven entirely by friction and in order to produce the helical sound record the optical system is moved across the width of the film by a lead screw which is in a fixed geared relation to the film driving surface, so that the film advances a definite distance for each foot of film carried past the recording point. The use of sprockets in the drive mechanism is entirely avoided.

The problems involved in the construction of a recording apparatus of this type are the provision of means for driving the film at a definite and uniform speed, the provision of means for guiding the film so that it is maintained in a definite lateral position, and appreciable side weave is prevented at the point where it passes the recording optical system, the provision of means for maintaining the film surface at an exact distance from the recording optical system across its entire width so that the recording image is kept in extremely critical focus, the provision of means for protecting the recording surface of the film from abrasion, the provision of means for moving the optical system of the recorder across the film at a predetermined rate and with a degree of accuracy such that the maximum error of position at any time during the recording that the helical sound track is started at a predetermined distance from the edge of the film.

The manner in which these various problems are solved, and the objects of the invention are realized, will be better understood from the following description when considered in connection with the accompanying drawings. The scope of the invention will be pointed out in the appended claims.

Referring to the drawings:

Fig. 1 illustrates partly in section a recording apparatus wherein the invention has been embodied;

Fig. 2 is an elevation partly in section showing the arrangement of the film supporting rollers, the cabinet which encloses these rollers and the optical system through which recording is effected;

Fig. 3 is a sectional view of the drum over which the film is passed in juxtaposition to the objective of the optical system;

Figs. 4, 4*a*, 5 and 6 show various features of the different rollers over which the film passes;

Fig. 7 illustrates the driving mechanism of the optical system; and

Fig. 8 illustrates a form of device arranged to cooperate with the drum of Fig. 3 for forming the light image at the surface of the film.

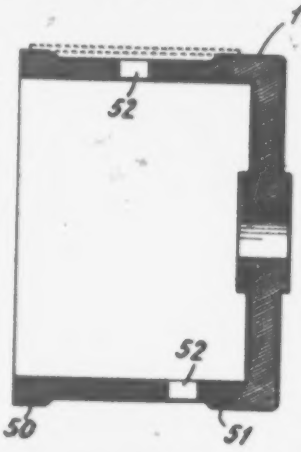
The apparatus illustrated in Fig. 1 includes a motor 10 which may be of the three-phase type and which is coupled to a film drum 11 through a shaft 12, a worm 13, a worm wheel 14 and a flywheel 15 mounted on a shaft 16, which is supported in bearings 17 and 18. It should be noted that the shaft 12 is provided with bearings 19 and 20 mounted on a base 9 which supports the other parts of the apparatus, and that the worm wheel 14 is arranged to float on or turn freely about the shaft 16, and is coupled to the flywheel 15 through resilient connections 21 which may assume any suitable form such as that described by United States Patent

Dec. 20, 1932. J. A. MAURER, JR 1,891,387

FILM PHONOGRAPH

Filed Oct. 28, 1931 3 Sheets-Sheet 3

Fig. 3



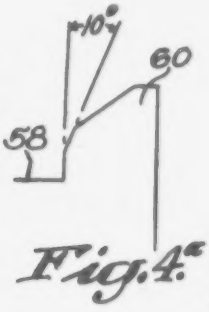


Fig. 4a

Fig. 5

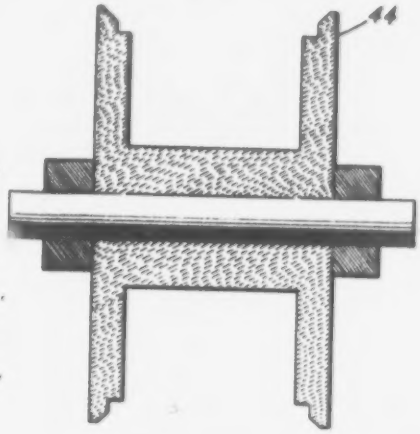


Fig. 4

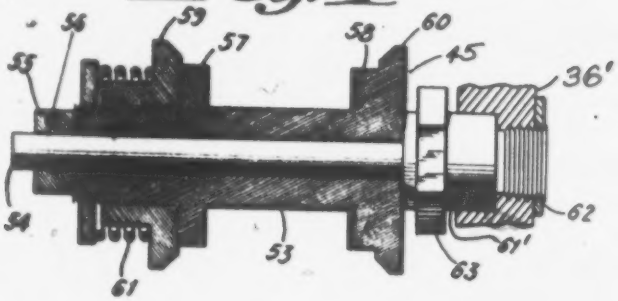


Fig. 6

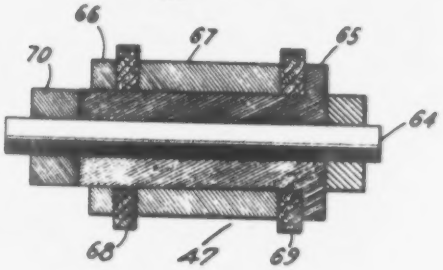


Fig. 7

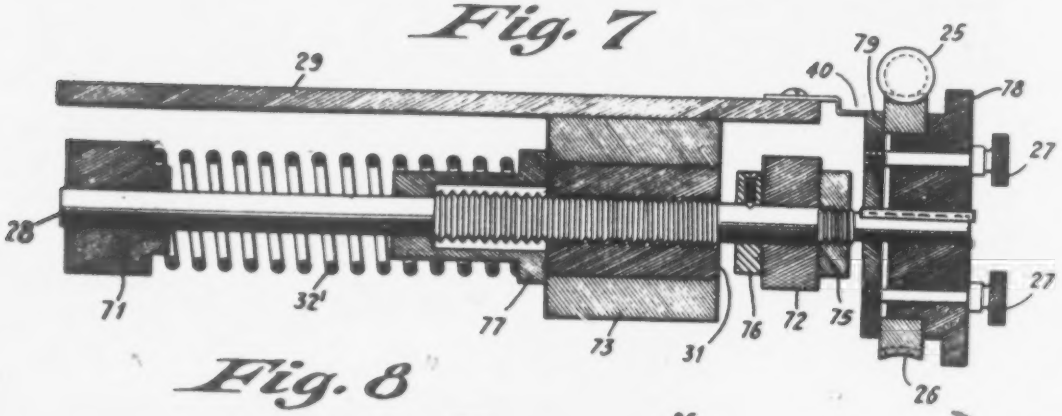
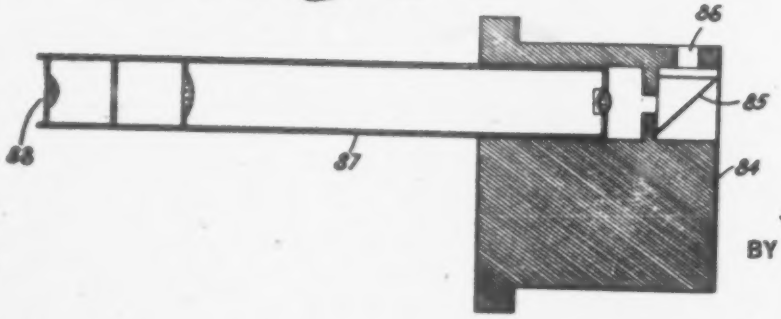


Fig. 8



INVENTOR
JOHN A. MAURER JR.
BY W. G. Grover
ATTORNEY

UNITED STATES PATENT OFFICE

JOHN A. MAURER, JR., OF NEW YORK, N. Y., ASSIGNOR TO RADIO CORPORATION OF AMERICA, A CORPORATION OF DELAWARE

FILM PHONOGRAPH

Application filed October 28, 1931. Serial No. 571,532.

This invention relates to the recording of sound and has for its principal object the provision of an improved sound recorder suitable for the production of sound records of the micro-photographic type. While specific data on the construction of a practical form of the apparatus are given, it will be apparent that the invention is not limited to this particular form.

The particular recorder herein described is designed to produce a photographic sound record in the form of a helix on a continuous loop or belt of film. The dimensions of the record track are almost microscopic; that is, of a width of the order of two thousandths of an inch. The spacing from center to center of the adjacent turns of the helical sound track is of the order of four thousandths of an inch.

In the recording of sound the film is driven entirely by friction and in order to produce the helical sound record the optical system is moved across the width of the film by a lead screw which is in a fixed geared relation to the film driving surface, so that the film advances a definite distance for each foot of film carried past the recording point. The use of sprockets in the drive mechanism is entirely avoided.

The problems involved in the construction of a recording apparatus of this type are the provision of means for driving the film at a definite and uniform speed, the provision of means for guiding the film so that it is maintained in a definite lateral position, and appreciable side weave is prevented at the point where it passes the recording optical system, the provision of means for maintaining the film surface at an exact distance from the recording optical system across its entire width so that the recording image is kept in extremely critical focus, the provision of means for protecting the recording surface of the film from abrasion, the provision of means for moving the optical system of the recorder across the film at a predetermined rate and with a degree of accuracy such that the maximum error of position at any time is small in comparison with the width of the sound track, and the provision of means for insuring that the helical sound track is started at a predetermined distance from the edge of the film.

The manner in which these various problems are solved, and the objects of the invention are realized, will be better understood from the following description when considered in connection with the accompanying drawings. The scope of the invention will be pointed out in the appended claims.

Referring to the drawings:

Fig. 1 illustrates partly in section a recording apparatus wherein the invention has been embodied;

Fig. 2 is an elevation partly in section showing the arrangement of the film supporting rollers. the cabinet which encloses these rollers and the optical system through which recording is effected;

Fig. 3 is a sectional view of the drum over which the film is passed in juxtaposition to the objective of the optical system;

Figs. 4, 4*a*, 5 and 6 show various features of the different rollers over which the film passes;

Fig. 7 illustrates the driving mechanism of the optical system; and

Fig. 8 illustrates a form of device arranged to cooperate with the drum of Fig. 3 for focusing the light image at the surface of the film.

The apparatus illustrated in Fig. 1 includes a motor 10 which may be of the three-phase type and which is coupled to a film drum 11 through a shaft 12, a worm 13, a worm wheel 14 and a flywheel 15 mounted on a shaft 16, which is supported in bearings 17 and 18. It should be noted that the shaft 12 is provided with bearings 19 and 20 mounted on a base 9 which supports the other parts of the apparatus, and that the worm wheel 14 is arranged to float on or turn freely about the shaft 16, and is coupled to the flywheel 15 through resilient connections 21 which may assume any suitable form such as that described by United States Patent 1,728,304. As will be readily understood, the spring linkage between the worm wheel 14 and the flywheel 15 constitute a mechanical filter

which prevents the transmission to the shaft 16 on which the film drum 11 is mounted, of irregularities in speed caused by inaccurate cutting of the gears and the like.

Mounted upon the shaft 16 at the end opposite to that on which the film drum 11, is mounted, is a gear 22 arranged to cooperate with a gear 23 mounted on a shaft 24 which is substantially parallel with the shaft 12 and is provided at its opposite end with a worm gear 25 in cooperative relation with a gear 26. The gear 26 is arranged to rotate loosely about its bearing, a clutch member provided with screws 27 being provided for the purpose of connecting it to a shaft or lead screw 28 through which the table 29 and the recording element 30 mounted on this table are driven.

The table 29 is movable in a dove tail bearing 6—7 (see Fig. 2) and is moved in this bearing in response to rotation of the screw 28 which cooperates with the nut 31 mounted in the bracket 73 on its under side.

Mounted on the under side of the table 29 is a nut 31 which meshes with the lead screw 28 for effecting movement of the objective of the optical system 32 across the film at the desired speed, which in the particular apparatus illustrated is four thousandths of an inch for each four and one-half feet of film movement. The action of the lead screw 28 in moving the table 29 is opposed by a powerful coil spring 32′ which is provided for the purpose of eliminating the effect of any looseness between the lead screw 28 and the nut 31 which would tend to produce inaccuracy in the movement of the optical system. As a further precaution, the lead screw 28 is arranged to push the table 29 in a direction which compresses the spring during the recording operation. In order to return the table to its starting position the clutch at the end of the lead screw 28 is loosened by means of the screws 27, and the lead screw is rotated either manually or automatically to return the table to the proper starting point. An indicating member 40 mounted on the table may be arranged to cooperate with an indicating mark on the clutch mechanism for insuring that the table is returned to the same point after each recording operation. The various details of the clutch and indicating mechanism are indicated in further detail in Fig. 7 hereinafter described.

For the purpose of preventing weave or sidewise movement of the film as it passes the objective of the optical system 32, a shoulder 33 and an adjustable screw collar 34 which bears against the end of the bronze bushing an opening 37 through which the objective of the optical system 32 is inserted, this insertion being made through a felt line jacket 38 mounted in a double slide arrangement which permits free movement of the optical system in a direction parallel with the shaft 16, and serves to exclude light from the enclosure 36. In order to permit film threading and observation of the parts mounted within the enclosure 36, a door 39 is provided.

As indicated in further detail by Fig. 2, the mechanism mounted within the enclosure 36 includes the drum 11 and idlers 41 to 46 over which the film passes, the idlers 45 and 46 serving to guide the film on to and off of the drum 11. As previously pointed out in connection with Fig. 1, the drum 11 is driven through the flywheel 15. Near the point at which the film leaves the drum 11 it is passed under a rubber-tired roller 47 which is spring pressed against the drum for the purpose of preventing slippage between the drum and the film. The idler 41 is pivoted at 48 and pressed against the film by means of a spring 49 which permits it to float in the slack end of the film loop. Thus the film is maintained under a definite tension throughout the entire system. If the various idlers turn freely on their bearings it has been found that this tension will hold the film in driving contact with the drum so that substantially no slippage occurs. The rubber-tired pressure roller 47 serves to prevent any possible slippage of the film on the drum. The construction of the various idlers and the rubber-tired roller are shown in greater detail in Figs. 4 and 6 hereinafter described.

A suitable construction of the drum 11 is shown in Fig. 3. It will be noted that the driving surfaces 50 and 51 are not provided with flanges, and that the central portion is recessed about ten one-thousandths of an inch to prevent contact with the film on the portion where sound is to be recorded. The position of the film is indicated by dotted lines. It has been found by experience that when a film is wrapped around the flange drum in the manner indicated, under a sufficient amount of tension which is not extremely critical, its surface will become truly cylindrical so that its line of intersection with the light beam from the optical system is a straight line. This insures that the recording image is in exact focus against the entire width of the film even though the film is unsupported at its central portion. A number of openings 52 are provided in the recessed portion of the drum to permit inspection of the recording image on the film by a micro-

is arranged to run without appreciable end play on a shaft 54, being held in its illustrated position by a collar 55 which is split and contracted on the shaft by a screw 56. This construction has the advantage that it readily lends itself to delicate adjustment. The film supporting surfaces 57 and 58 touch the film only at the edges not used for the record. The edges of the film are held between the shoulders 59 and 60, and are forced by a spring 61 in such a direction as to hold the film tightly against the shoulder 60. As indicated by the drawings, the shoulders 59 and 60 are tapered at an angle of about ten degrees except for a short distance above the film bearing surfaces, where, for a distance approximately ten thousandths of an inch, they are flat and perpendicular to the axis of rotation. This construction has the advantage that it permits the film to enter the guide rollers and seat firmly against the perpendicular bearing surfaces. The spring 61 provides compensation for slight differences in film width. The surface 61′ fits into an opening in the supporting plate on which the guide roller is mounted, and serves to maintain the roller shaft accurately perpendicular to the supporting plate. The screw thread 62 engages a female thread in the supporting plate or wall 36′, so that by turning the part 63 which is hexagonal, with a wrench, the spindle may be adjusted endwise, a locking nut being arranged to cooperate with the thread 62 for locking the idler in any desirable position.

It is apparent that the edges of the film are held in a definite position as it passes around the rollers 45 and 46. These two rollers are adjusted so that their solid guiding edges are the same distance from the supporting plate, the surface of which is perpendicular to the axis of the shaft 16 on which the drum 11 is mounted. As a result, the film travels around the drum in the same position, with no tendency to slip endwise. Thus the two guide rollers serve the purpose of maintaining the film in a definite position on the drum. It has been found that this position is maintained during the operation of the apparatus well within the permissible tolerance of .0002 of an inch.

The construction of the idlers 41 to 44 is indicated in Fig. 5. These idlers differ only in diameter. Their flanges are placed wide enough apart to receive the widest unshrunken film stock. As in the case of the guide rollers 45 and 46, they are arranged to contact with the film only on the edges beyond the recording area.

The constructional details of the rubber-tired roller 47 are shown in Fig. 6. This [illegible] 69 are compressed. The outer surfaces of the rubber washers are ground to true concentricity with the bearing by a high speed carborundum cutting wheel or the like. The spacing between these washers is such that they cooperate with the driving surfaces of the drum and do not touch any part of the film used for the record. The collar 70 is provided for preventing end play of the roller.

The construction of the lead screw 28 and its associated parts is illustrated in Fig. 7. It will be noted that this screw is supported by massive bearings 71 and 72, that the nut 31 is arranged to cooperate with a threaded portion of the lead screw over a considerable length, and is ground to fit it after turning. This process averages the errors of the screw and gives a smoother and more accurate drive than would normally be obtained. The nut 31 is supported in a bracket 73 which in turn is supported by the table 29. For the purpose of preventing end play a threaded collar 75 is arranged to clamp a shoulder 76 tightly against the bearing 72. As previously indicated, the spring 32′ prevents lost motion between the nut and the lead screw. At the left hand end of the nut 31 the collar 77 is provided for supporting the spring 32 and protecting the lead screw from dust and other foreign matter.

The operation of the clutch through which the shafts 28 and 16 are coupled together will be readily understood. It includes a member 78 which is fixed to the shaft 28 and a member 79 which is arranged to be clamped to the gear 26 by means of the screws 27. The index member 40 carries a mark which can be used in conjunction with a mark on the member 79 to establish a definite starting position of the recording operation. When the screws 27 are tightened, the table 29 of course begins to move to the left from the starting point, thus insuring that the helical record is begun at a predetermined distance from the edge of the film.

The optical system of the recorder 30 may be of any suitable form. In order to render it suitable for recording of extremely narrow sound tracks, the objective lens should have a focal length of the order of four millimeters, and the distance between the objective lenses and the mechanical slit 80 (see Fig. 1) should be greater than is used in present sound motion picture recorders. This results in the imaging of the fixed slit on the film at a ratio of the order of sixty to one instead of four to one as is usual in commercial recorders of this type. Because of the small depth of focus of the short focus

which prevents the transmission to the shaft 16 on which the film drum 11 is mounted, of irregularities in speed caused by inaccurate cutting of the gears and the like.

Mounted upon the shaft 16 at the end opposite to that on which the film drum 11 is mounted, is a gear 22 arranged to cooperate with a gear 23 mounted on a shaft 24 which is substantially parallel with the shaft 12 and is provided at its opposite end with a worm gear 25 in cooperative relation with a gear 26. The gear 26 is arranged to rotate loosely about its bearing, a clutch member provided with screws 27 being provided for the purpose of connecting it to a shaft or lead screw 28 through which the table 29 and the recording element 30 mounted on this table are driven.

The table 29 is movable in a dove tail bearing 6—7 (see Fig. 2) and is moved in this bearing in response to rotation of the screw 28 which cooperates with the nut 31 mounted in the bracket 73 on its under side.

Mounted on the under side of the table 29 is a nut 31 which meshes with the lead screw 28 for effecting movement of the objective of the optical system 32 across the film at the desired speed, which in the particular apparatus illustrated is four thousandths of an inch for each four and one-half feet of film movement. The action of the lead screw 28 in moving the table 29 is opposed by a powerful coil spring 32′ which is provided for the purpose of eliminating the effect of any looseness between the lead screw 28 and the nut 31 which would tend to produce inaccuracy in the movement of the optical system. As a further precaution, the lead screw 28 is arranged to push the table 29 in a direction which compresses the spring during the recording operation. In order to return the table to its starting position the clutch at the end of the lead screw 28 is loosened by means of the screws 27, and the lead screw is rotated either manually or automatically to return the table to the proper starting point. An indicating member 40 mounted on the table may be arranged to cooperate with an indicating mark on the clutch mechanism for insuring that the table is returned to the same point after each recording operation. The various details of the clutch and indicating mechanism are indicated in further detail in Fig. 7 hereinafter described.

For the purpose of preventing weave or sidewise movement of the film as it passes the objective of the optical system 32, a shoulder 33 and an adjustable screw collar 34 which bears against the end of the bronze bushing 35 within which the shaft 16 turns, are provided. By suitable adjustment of the collar 34 any appreciable end play of the shaft is eliminated.

The film drum 11 is surrounded by a light tight enclosure 36 which is provided with an opening 37 through which the objective of the optical system 32 is inserted, this insertion being made through a felt line jacket 38 mounted in a double slide arrangement which permits free movement of the optical system in a direction parallel with the shaft 16, and serves to exclude light from the enclosure 36. In order to permit film threading and observation of the parts mounted within the enclosure 36, a door 39 is provided.

As indicated in further detail by Fig. 2, the mechanism mounted within the enclosure 36 includes the drum 11 and idlers 41 to 46 over which the film passes, the idlers 45 and 46 serving to guide the film on to and off of the drum 11. As previously pointed out in connection with Fig. 1, the drum 11 is driven through the flywheel 15. Near the point at which the film leaves the drum 11 it is passed under a rubber-tired roller 47 which is spring pressed against the drum for the purpose of preventing slippage between the drum and the film. The idler 41 is pivoted at 48 and pressed against the film by means of a spring 49 which permits it to float in the slack end of the film loop. Thus the film is maintained under a definite tension throughout the entire system. If the various idlers turn freely on their bearings it has been found that this tension will hold the film in driving contact with the drum so that substantially no slippage occurs. The rubber-tired pressure roller 47 serves to prevent any possible slippage of the film on the drum. The construction of the various idlers and the rubber-tired roller are shown in greater detail in Figs. 4 and 6 hereinafter described.

A suitable construction of the drum 11 is shown in Fig. 3. It will be noted that the driving surfaces 50 and 51 are not provided with flanges, and that the central portion is recessed about ten one-thousandths of an inch to prevent contact with the film on the portion where sound is to be recorded. The position of the film is indicated by dotted lines. It has been found by experience that when a film is wrapped around the flange drum in the manner indicated, under a sufficient amount of tension which is not extremely critical, its surface will become truly cylindrical so that its line of intersection with the light beam from the optical system is a straight line. This insures that the recording image is in exact focus against the entire width of the film even though the film is unsupported at its central portion. A number of openings 52 are provided in the recessed portion of the drum to permit inspection of the recording image on the film by a microscope placed inside the drum. The construction of this microscope is indicated in Fig. 8 hereinafter described.

Fig. 4 shows the details in the construction of the guide rollers or idlers 45 and 46. These rollers comprise a member 53, which

trated position by a collar 55 which is split and contracted on the shaft by a screw 56. This construction has the advantage that it readily lends itself to delicate adjustment. The film supporting surfaces 57 and 58 touch the film only at the edges not used for the record. The edges of the film are held between the shoulders 59 and 60, and are forced by a spring 61 in such a direction as to hold the film tightly against the shoulder 60. As indicated by the drawings, the shoulders 59 and 60 are tapered at an angle of about ten degrees except for a short distance above the film bearing surfaces, where, for a distance approximately ten thousandths of an inch, they are flat and perpendicular to the axis of rotation. This construction has the advantage that it permits the film to enter the guide rollers and seat firmly against the perpendicular bearing surfaces. The spring 61 provides compensation for slight differences in film width. The surface 61′ fits into an opening in the supporting plate on which the guide roller is mounted, and serves to maintain the roller shaft accurately perpendicular to the supporting plate. The screw thread 62 engages a female thread in the supporting plate or wall 36′, so that by turning the part 63 which is hexagonal, with a wrench, the spindle may be adjusted endwise, a locking nut being arranged to cooperate with the thread 62 for locking the idler in any desirable position.

It is apparent that the edges of the film are held in a definite position as it passes around the rollers 45 and 46. These two rollers are adjusted so that their solid guiding edges are the same distance from the supporting plate, the surface of which is perpendicular to the axis of the shaft 16 on which the drum 11 is mounted. As a result, the film travels around the drum in the same position, with no tendency to slip endwise. Thus the two guide rollers serve the purpose of maintaining the film in a definite position on the drum. It has been found that this position is maintained during the operation of the apparatus well within the permissible tolerance of .0002 of an inch.

The construction of the idlers 41 to 44 is indicated in Fig. 5. These idlers differ only in diameter. Their flanges are placed wide enough apart to receive the widest unshrunken film stock. As in the case of the guide rollers 45 and 46, they are arranged to contact with the film only on the edges beyond the recording area.

The constructional details of the rubber-tired roller 47 are shown in Fig. 6. This part of the apparatus includes a shaft 64 on which is mounted a bronze center piece 65 which has forced over it the two sleeves 66 and 67 whereby the rubber washers 68 and centricity with the bearing by a high speed carborundum cutting wheel or the like. The spacing between these washers is such that they cooperate with the driving surfaces of the drum and do not touch any part of the film used for the record. The collar 70 is provided for preventing end play of the roller.

The construction of the lead screw 28 and its associated parts is illustrated in Fig. 7. It will be noted that this screw is supported by massive bearings 71 and 72, that the nut 31 is arranged to cooperate with a threaded portion of the lead screw over a considerable length, and is ground to fit it after turning. This process averages the errors of the screw and gives a smoother and more accurate drive than would normally be obtained. The nut 31 is supported in a bracket 73 which in turn is supported by the table 29. For the purpose of preventing end play a threaded collar 75 is arranged to clamp a shoulder 76 tightly against the bearing 72. As previously indicated, the spring 32′ prevents lost motion between the nut and the lead screw. At the left hand end of the nut 31 the collar 77 is provided for supporting the spring 32 and protecting the lead screw from dust and other foreign matter.

The operation of the clutch through which the shafts 28 and 16 are coupled together will be readily understood. It includes a member 78 which is fixed to the shaft 28 and a member 79 which is arranged to be clamped to the gear 26 by means of the screws 27. The index member 40 carries a mark which can be used in conjunction with a mark on the member 79 to establish a definite starting position of the recording operation. When the screws 27 are tightened, the table 29 of course begins to move to the left from the starting point, thus insuring that the helical record is begun at a predetermined distance from the edge of the film.

The optical system of the recorder 30 may be of any suitable form. In order to render it suitable for recording of extremely narrow sound tracks, the objective lens should have a focal length of the order of four millimeters, and the distance between the objective lenses and the mechanical slit 80 (see Fig. 1) should be greater than is used in present sound motion picture recorders. This results in the imaging of the fixed slit on the film at a ratio of the order of sixty to one instead of four to one as is usual in commercial recorders of this type. Because of the small depth of focus of the short focus objective lens it is necessary to provide a focusing movement of considerably greater delicacy than that customarily provided. The recorder 31 (see Fig. 1) is diagrammatically indicated as of the galvanometer va-

riable area type, light from a source 81 being projected through a lens 82 to the galvanometer mirror 83, from it is reflected into the optical element 32. Since recorders of this type are well known to those skilled in the art, a detailed description of it is believed to be unnecessary.

Fig. 8 illustrates a microscopic device which is adapted to be inserted in the drum 11 for the purpose of focusing the light image on the film. This device is provided with a block 84 which fits inside the drum 11, and with a prism 85 by which light entering through the openings 52 of the drum 11 and an opening 86 of the member 84 is reflected through a microscope 87 to the eyepiece 88. The microscope may be equipped with a 32 mm. objective and a 10 times ocular. This microscope is focused through the prism and hole 86 on the film surface, which may be scratched with fine emery in order to give distinct marks for focusing. The recording image is then brought into sharp focus while watching its appearance through the microscope. By following this method it has been found that an extremely precise focus can be obtained.

Attention is called to the fact that the broader aspects of the frictionally driven film and movable optical system combination are covered in a copending application Serial No. 571,533, filed October 28, 1931, and assigned to the same assignee as the present application.

Having thus described my invention and the operation thereof, what I claim is:

1. An apparatus for recording sound on a continuous loop of light sensitive film including frictional means for moving said film at a substantially uniform linear speed, and means for moving a recording light beam across said film at a rate of speed proportional to said linear speed.

2. An apparatus for recording sound on a continuous loop of light sensitive film including frictional means for moving said film at a substantially uniform linear speed, means including an optical system for producing a light beam modulated in accordance with the sound to be recorded, and means for moving said system laterally of said film at a speed dependent on said linear speed.

3. An apparatus for recording sound on a continuous loop of light sensitive film including frictional means for moving said film at a substantially uniform linear speed, means for producing a light beam modulated in accordance with the sound to be recorded, and means for moving said beam laterally

an optical system for producing a light beam modulated in accordance with the sound to be recorded, and a mechanical coupling interposed between said roller and said system for moving said beam laterally of said film.

5. An apparatus for recording sound on a light sensitive film arranged in the form of a continuous loop including a frictional drive roller for moving said film, means including an optical system for producing a light beam modulated in accordance with the sound to be recorded, and means positively geared to said roller for moving said system laterally of said film.

6. An apparatus for recording sound on a light sensitive film arranged in the form of a continuous loop including a frictional drive roller for moving said film, means including an optical system mechanically coupled to said roller for producing a light beam modulated in accordance with the sound to be recorded, and means for disconnecting said system from said roller to permit its return to a predetermined starting position.

7. Apparatus for recording sound on a light sensitive film arranged in the form of a continuous loop including frictional means for driving said film, means for producing a light beam modulated in accordance with the sound to be recorded, means for moving said light beam laterally across said film at a speed proportional to the movement of said film, and means arranged to permit said beam to be moved independently of said film.

8. Apparatus for recording sound on a light sensitive film including a roller arranged to drive said film through frictional contact, means for driving said roller, inertia means fixed to said roller, a resilient coupling interposed between said driving and inertia means, means for producing a light beam modulated in accordance with the sound to be recorded, and means interposed between said roller and said beam producing means for moving said beam across said film at a speed proportional to the surface speed of said roller.

9. Apparatus for recording sound on a light sensitive film including a roller arranged to drive said film through frictional contact, means for driving said roller, inertia means fixed to said roller, a resilient coupling interposed between said driving and inertia means, means for producing a light beam modulated in accordance with the sound to be recorded, a resilient member, and means interposed between said roller and said beam producing means for moving the latter against the pressure of said member laterally

coupling means interposed between said film driving and beam producing means for moving said light beam laterally of said film at a speed proportional to the speed of said film, means arranged to permit independent movement of said beam to a predetermined point, and means for indicating when said point is reached.

11. Apparatus for recording sound on a light sensitive film including means for driving said film through frictional contact, means for producing a light beam modulated in accordance with the sound to be recorded, coupling means interposed between said film driving and beam producing means for moving said light beam laterally of said film at a speed proportional to the speed of said film, and resilient means arranged to be controlled by movement of said beam producing means for eliminating irregularity in said beam movement.

JOHN A. MAURER, JR.

riable area type, light from a source 81 being projected through a lens 82 to the galvanometer mirror 83, from it is reflected into the optical element 32. Since recorders of this type are well known to those skilled in the art, a detailed description of it is believed to be unnecessary.

Fig. 8 illustrates a microscopic device which is adapted to be inserted in the drum 11 for the purpose of focusing the light image on the film. This device is provided with a block 84 which fits inside the drum 11, and with a prism 85 by which light entering through the openings 52 of the drum 11 and an opening 86 of the member 84 is reflected through a microscope 87 to the eyepiece 88. The microscope may be equipped with a 32 mm. objective and a 10 times ocular. This microscope is focused through the prism and hole 86 on the film surface, which may be scratched with fine emery in order to give distinct marks for focusing. The recording image is then brought into sharp focus while watching its appearance through the microscope. By following this method it has been found that an extremely precise focus can be obtained.

Attention is called to the fact that the broader aspects of the frictionally driven film and movable optical system combination are covered in a copending application Serial No. 571,533, filed October 28, 1931, and assigned to the same assignee as the present application.

Having thus described my invention and the operation thereof, what I claim is:

1. An apparatus for recording sound on a continuous loop of light sensitive film including frictional means for moving said film at a substantially uniform linear speed, and means for moving a recording light beam across said film at a rate of speed proportional to said linear speed.

2. An apparatus for recording sound on a continuous loop of light sensitive film including frictional means for moving said film at a substantially uniform linear speed, means including an optical system for producing a light beam modulated in accordance with the sound to be recorded, and means for moving said system laterally of said film at a speed dependent on said linear speed.

3. An apparatus for recording sound on a continuous loop of light sensitive film including frictional means for moving said film at a substantially uniform linear speed, means for producing a light beam modulated in accordance with the sound to be recorded, and means for moving said beam laterally of said film at a speed proportional to said linear speed.

4. An apparatus for recording sound on a light sensitive film arranged in the form of a continuous loop including a frictional drive roller for moving said film, means including an optical system for producing a light beam modulated in accordance with the sound to be recorded, and a mechanical coupling interposed between said roller and said system for moving said beam laterally of said film.

5. An apparatus for recording sound on a light sensitive film arranged in the form of a continuous loop including a frictional drive roller for moving said film, means including an optical system for producing a light beam modulated in accordance with the sound to be recorded, and means positively geared to said roller for moving said system laterally of said film.

6. An apparatus for recording sound on a light sensitive film arranged in the form of a continuous loop including a frictional drive roller for moving said film, means including an optical system mechanically coupled to said roller for producing a light beam modulated in accordance with the sound to be recorded, and means for disconnecting said system from said roller to permit its return to a predetermined starting position.

7. Apparatus for recording sound on a light sensitive film arranged in the form of a continuous loop including frictional means for driving said film, means for producing a light beam modulated in accordance with the sound to be recorded, means for moving said light beam laterally across said film at a speed proportional to the movement of said film, and means arranged to permit said beam to be moved independently of said film.

8. Apparatus for recording sound on a light sensitive film including a roller arranged to drive said film through frictional contact, means for driving said roller, inertia means fixed to said roller, a resilient coupling interposed between said driving and inertia means, means for producing a light beam modulated in accordance with the sound to be recorded, and means interposed between said roller and said beam producing means for moving said beam across said film at a speed proportional to the surface speed of said roller.

9. Apparatus for recording sound on a light sensitive film including a roller arranged to drive said film through frictional contact, means for driving said roller, inertia means fixed to said roller, a resilient coupling interposed between said driving and inertia means, means for producing a light beam modulated in accordance with the sound to be recorded, a resilient member, and means interposed between said roller and said beam producing means for moving the latter against the pressure of said member laterally of said film.

10. Apparatus for recording sound on a light sensitive film including means for driving said film through frictional contact, means for producing a light beam modulated in accordance with the sound to be recorded,

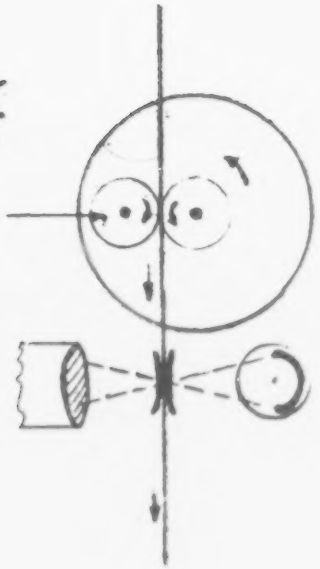
driving and beam producing means for moving said light beam laterally of said film at a speed proportional to the speed of said film, means arranged to permit independent movement of said beam to a predetermined point, and means for indicating when said point is reach[illegible].

11. Apparatus for recording sound on a light sensitive film including means for driving said film through frictional contact, means for producing a light beam modulated in accordance with the sound to be recorded, coupling means interposed between said film driving and beam producing means for moving said light beam laterally of said film at a speed proportional to the speed of said film, and resilient means arranged to be controlled by movement of said beam producing means for eliminating irregularity in said beam movement.

JOHN A. MAURER, JR.

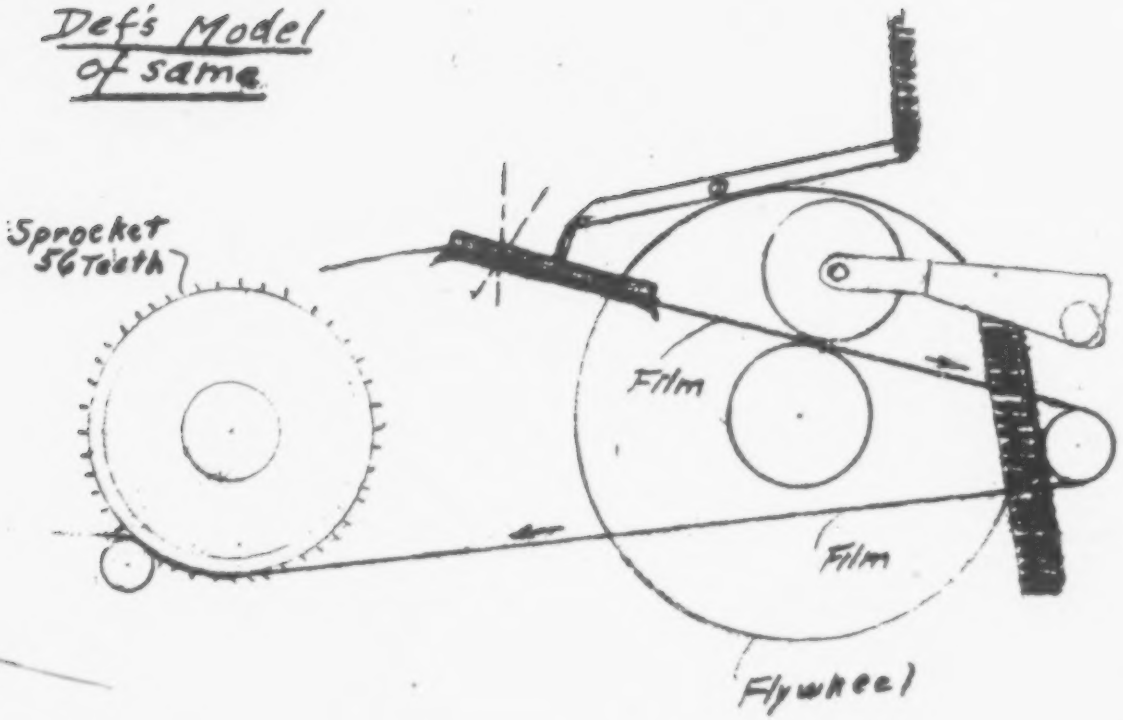
PLAINTIFFS' EXHIBIT NO. 46.

German Pat 387055 Fig. 1.



U.S. DISTRICT COURT
M. D. PENN.
COMPL. EX.

Def's Model of same



PLAINTIFFS' EXHIBIT NO. 47.

A New Type of Indicator for High-Speed Internal-Combustion Engines

By PROF. AUGUSTUS TROWBRIDGE
Member National Research Council

New diagram, electrically transmitted, shows velocity of cylinder pressure changes at every instant instead of actual pressures. Usual form for ascertaining power consumption may be constructed mathematically from it.

WHEN one thinks of the important rôle played by the steam-engine indicator in the development of the modern steam engine, one is surprised that in the development of the modern high-speed internal-combustion engine the indicator has played so small a part. Improvement in the internal-combustion engine has been directed more toward greater flexibility and reliability in use by amateur operators than toward greater economy in operation of large units by professional engineers. From what appear to have been purely empirical methods has been evolved a satisfactory general type of motor for automotive purposes, the various examples of which put out by the various makers differ but little in what are regarded as the main features of design. The relative importance of these main features of design is, however, more a matter of inference from block tests of over-all engine efficiency and thermodynamic considerations based on suppositious cylinder conditions than of experimental study of the actual conditions existing in the cylinder at every instant during the cycle.

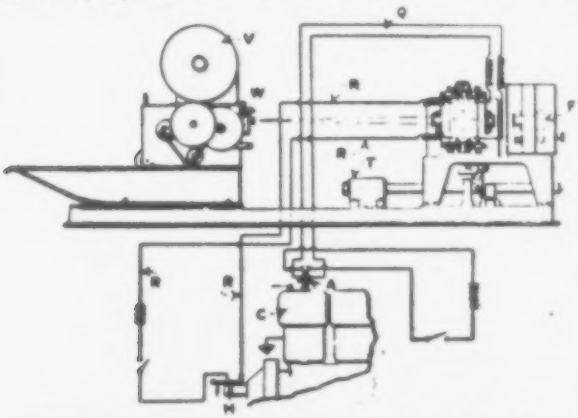


FIG. 1. DIAGRAM SHOWING ARRANGEMENT OF INDICATOR AND RECORDER

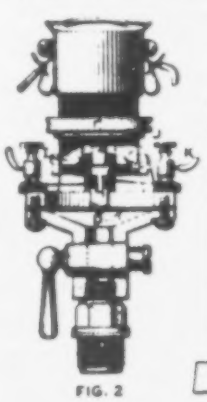


FIG. 2

FIG. 2. THE INDICATOR

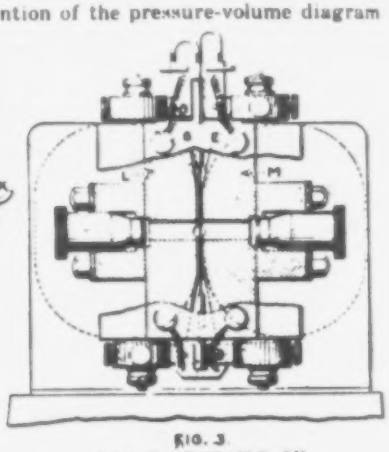


FIG. 3

FIG. 3. DETAILS OF RECORDER

Early attempts to ascertain these conditions by the use of indicators were not encouraging, chiefly because engineers employed either the existing steam-engine indicator or special indicators of the steam-engine type which retained many features that rendered their use misleading when employed at speeds far in excess of those for which they were designed. It is, of course, quite evident that an indicator, the inertia of whose moving parts would introduce no errors at one hundred revolutions per minute, might be utterly unreliable when used at 2,000 r.p.m., and this failure of the standard type of indicator to admit of adaptation to the needs of the automotive engineer has probably done much to restrict its use and that of the types of indicator more suitable for internal-combustion engines, which have been devised in recent years. These latter, for the most part, retain the feature of the steam indicator of linking the card to the piston so as to furnish a diagram in which the pressure in the cylinder at any instant is plotted as a function of the volume that the hot gases exerting this pressure occupy at this same instant. This has the advantage that it furnishes a pressure-volume diagram with which engineers are familiar and from which it is easy to derive the indicated horsepower by measuring the area of the surface inclosed by the lines of the pressure-volume cycle. There are, however, certain disadvantages which result from a retention of the pressure-volume diagram in work with high-speed internal-combustion engines which will be pointed out and discussed later in this article.

The chief improvement of the more modern indicators over the original steam-engine type consists in the reduction of the inertia of the moving parts which has been accomplished by the substitution of a steel diaphragm for the small piston, with a tiny mirror, the suitable connection of which to diaphragm and crankshaft produces a rotating effect about two axes, and consequent projection by a pencil of light upon ground glass or sensitized tape of a curve, the co-ordinates of which are the pressure at any instant in the cylinder and the corresponding value of the volume occupied by the gases exerting this pressure at the same instant.

The writer has not used the commercial form of this indicator, though he has studied a great number of photographic records obtained through its use. On the whole, the performance of the instrument seems to be good except that (a) a very slight lost motion in the mounting of the mirror may cause the photographic record to show spurious loops; (b) the jar of the

engine to which the recording mechanism is rigidly attached is communicated to the spot of light and the trace of this is not so fine a line as it could otherwise be; (c) on account of the size of the entire assembly it cannot be easily mounted close enough to the engine cylinder to avoid waves being set up in the pipe connections, which must be neither too small nor too large to assure a true pressure record.

There is no simple means of electrically transmitting a record of the actual position of a moving body, but it is an extremely simple matter to transmit a record of its velocity at every instant of its motion. From a record of its position at any known instant and its varying velocity at each and every succeeding instant, it is a simple geometrical matter to find its position at each and every instant. Electromagnetic induction furnishes a simple means of recording the velocity at which a body is moving—the current induced in a small coil attached to the moving diaphragm, and so mounted that any one of the circular turns of the coil lies in a magnetic field radiating from the center of the circle, is proportional to the velocity with which the turn (or turns) of wire move in the direction at right angles to the plane of the magnetic field.

In Fig. 1, which shows in diagrammatic form the general arrangement of indicator and recorder, the indicator is shown at *A* mounted on one of the cylinders *C* of a gasoline engine. Fig. 2 shows an elevation (partly in section) of the indicator; the coil referred to is shown at *I* and the diaphragm to which the coil is rigidly attached at *D*. The internal pole of the magnet providing the field which runs radially through the coil is shown at *J* and the other (ring-shaped) at *K*. As will be seen from Fig. 2, an up and down motion of the diaphragm *D* causes the coil *I* to

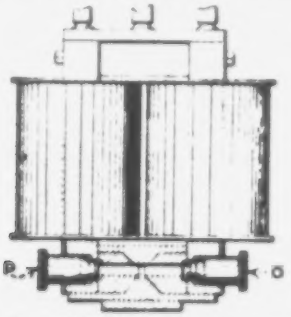


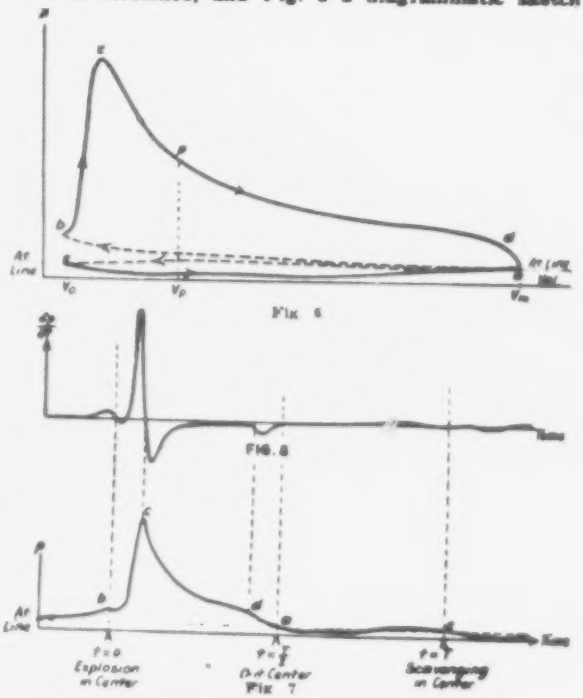
FIG. 4. PLAN OF RECORDER MAGNET

FIG. 5. DIAGRAM SHOWING ARRANGEMENT OF RECORDER LENSES

move across the radial magnetic field and by this motion to induce currents in the circuit of the coil which are in one direction as the diaphragm rises, in the opposite direction when the diaphragm falls, and zero when the diaphragm is at rest in any position.

To record this current it is conducted through a very fine wire about 0.0004 in. in diameter, shown connected to the coil by the wires *Q* of Fig. 1 and as *E* in Figs. 3 and 5. This fine wire is mounted between the poles *L* and *M* of a powerful electromagnet and at right angles to the direction of its uniform magnetic field. When a current flows in wire *E*, it is urged at right angles both to its own length and to the direction of the field of the electromagnet or at right angles to the plane of the drawing.

Fig. 4 is a plan of the electromagnet which shows how the polepieces are shaped so as to provide an intense magnetic field in the region in which the fine wire is stretched, and Fig. 5 a diagrammatic sketch



FIGS. 6, 7 AND 8. TYPICAL CURVE DIAGRAMS

in plan. If the current in the wire flows in one direction, it is urged from the position *E*, Fig. 5, toward the position *G* and vice versa, while by means of suitable lenses *N*, *O*, *P*, *U*, Fig. 5, for illumination and concentration of the light from the electric bulb *F*, a shadow of the fine wire may be made to appear as a tiny black spot in an illuminated field of light on the face of a recording camera *W*, Figs. 1 and 5, and motion of this spot photographed on a strip of sensitized paper *B*, Fig. 5, which is fed through the camera in which it is automatically developed, fixed and washed, and delivered in a form suitable for filing.

The advantages of this electromagnetic method of recording the motion of the diaphragm subjected to the pressure existing in the engine cylinder are: (1) The light coil of wire attached to the diaphragm does not seriously affect its motion; (2) there are no mechanical linkages or leverages to cause lost motion; (3) jars to the engine are not transmitted to the recording mechanism either mechanically or electrically; (4) the motion of the fine wire causing the shadow-photograph is strictly proportional to the velocity of the diaphragm to which it is electromagnetically connected, and because of its extreme lightness there are practically no inertia effects; (5) owing to the absence of vibration of the electromagnetic transmission there is a clearness and sharpness of the resulting record which makes it easy to read and interpret.

The objection to the electromagnetic method of recording is that it does not show the pressure at every

instant of the stroke, but rather the rate of variation of this pressure with the time at every instant. As explained further on, it is purely a matter of simple geometry to convert this form of record into that in which the pressure is given as a function of the time if it is so desired. The experience of the writer has been, however, that this geometrical transformation is by no means necessary, as one quickly acquires a facility in interpreting the original record so that quite as much, if not more, information may be obtained from it as from a record of the pressure with the time. For quantitative, as distinguished from comparative work, however, such as measurement of indicated horsepower, it would be necessary to convert by a simple geometric construction the record directly obtained into the standard form of indicator diagram. If it is not desired to obtain a quantitative value of the indicated horsepower, but merely to compare the explosions in a cylinder under different working conditions or to compare the explosions in the several cylinders of an engine, or to determine accurately the effect of slight changes in the timing, lift, etc., of the valves, or in the timing of the ignition, it is not only unnecessary to convert the original experimental records into the standard indicator-diagram form—it is actually easier and more accurate to make measurements on the original records.

In order to determine the position of the crankshaft with reference to the pressure record produced by the fine wire *E* already described, another and similar wire *G*, shown in Figs. 3 and 5, is located close to and parallel with *E*, so that when in normal position

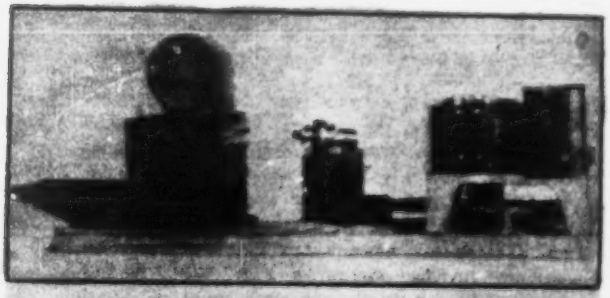


FIG. 9. INDICATOR ON ITS SIDE ON A BOX

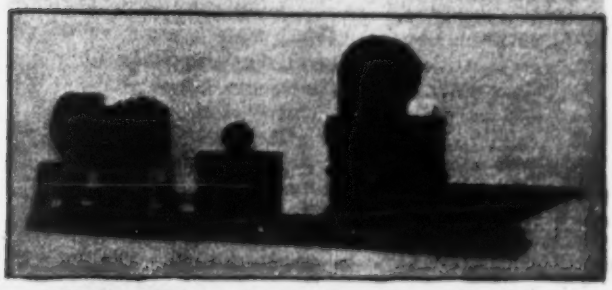


FIG. 10. REAR VIEW OF PARTS SHOWN IN FIG. 9

its presence would be indicated on the record tape as a straight line. As indicated at *H*, *R*, Fig. 1, however, this wire is in circuit with an auxiliary dry battery provided with a circuit closer operated at every revolution of the engine shaft, thus making an indentation or "jog" for reference purposes.

Another automatically operated time-recording feature comprises an electrically energized timing fork shown at *T* in Fig. 1, which, acting through the fields of a tiny alternating-current motor, controls the speed of a wire-spoked rotor indicated at *S* in Fig. 5, which by means of the cylindrical lens *U* projects a sharply defined shadow on the sensitized ribbon at intervals of $\frac{1}{10}$ second, resulting in a series of transverse lines in the completed record, which therefore contains (a) the time scale, (b) the time marks indicating the piston position, and (c) the curve showing pressure variations within the cylinder.

Figs. 9, 10 and 11 in conjunction with the diagrams show quite clearly the various parts of the actual apparatus. In Fig. 9 the indicator is shown lying on its side on a box; Fig. 10 gives a rear view of the same parts shown in Fig. 9, and Fig. 11 gives a larger view of the photographic and time-scale apparatus.

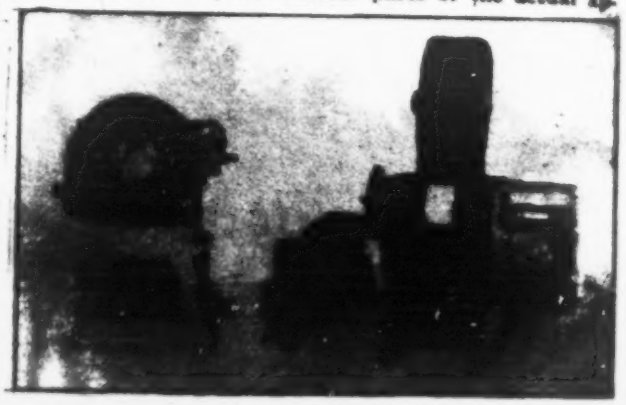


FIG. 11. VIEW OF PHOTOGRAPHIC AND TIME-SCALE APPARATUS

The only portion of the recorder that is in continuous operation during use is the time-recording mechanism. All other moving parts are controlled by a suitable foot switch which is depressed when a record is desired. This switch throws current to the lamp *F*, Fig. 5, excites the electromagnet, Fig. 3, and that which furnishes the field for the indicator, Fig. 2, and starts to feed the photographic paper from the magazine *V* of the recorder through the rollers and into the developing and fixing solutions. When the record has been taken, a knife cuts the paper and the exposed portion continues to feed through the solutions until it appears developed, fixed and washed.

The recording mechanism is arranged so that the exposure is made at any desired speed and the development at another, so as to insure the best obtainable contrast between light and shadow on the record.

Fig. 12 shows a record of pressure variations in a cylinder at 540 r.p.m., with retarded spark. The indications on the extreme lower edge of the record show the "in center" and "out center" positions of the piston. The sudden rapid rate of rise of the pressure shown on the main trace of the record comes slightly after the explosion "in center" position. The attainment of maximum pressure occurs when this trace crosses the horizontal line drawn through the undisturbed portions of the trace. In Fig. 12 this maximum pressure occurs $\frac{1}{100}$ second after the "in center" position and this corresponds to $\frac{1}{100} \times \frac{540}{60} \times 360$ deg. = 32.4 deg. of crankshaft motion after the "in center" position. Where the trace shows a maximum below its zero line, the pressure is falling most rapidly. This

occurs $\frac{15}{1,000}$ second after "in center" or $\frac{15}{1,000} \times \frac{540}{60}$ = 3:0 = 48.6 deg. of crankshaft motion after "in center." The pressure continues to fall, but less rapidly after this until the exhaust valve begins to open as shown by the trace beginning again to drop toward a second and rather flat maximum below its zero line. This begins $\frac{44}{1,000}$ second after explosion "in center," which corresponds to 142 deg. of crankshaft and the valve is wide open $\frac{5}{100}$ second after "in center," which corresponds to 162 deg. of crankshaft.

Fig. 13 shows the same engine running at approximately the same speed of revolution but with the spark more advanced. The rate of rise of the pressure is seen to be much more abrupt. Maximum pressure occurs 14.5 deg. of crankshaft after explosion "in center." Violent and rapid pressure variations occur during the portion of the cycle just after "in center," as shown by the broken character of the trace. This is the record of the "knock" due to an abnormally advanced spark. Fig. 14 is the record of one explosion between two "misfires" in the cylinder of a large four-cylinder engine provided with an automatic centrifugal governor for the spark advance. The engine was only lightly loaded and was making 1,824 r.p.m.

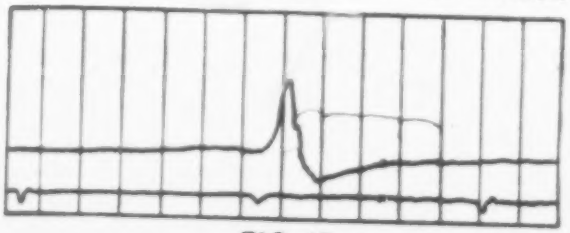


FIG. 12

FIG. 13

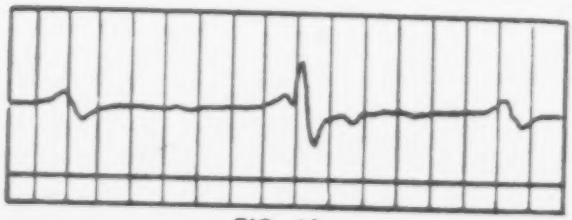


FIG. 14

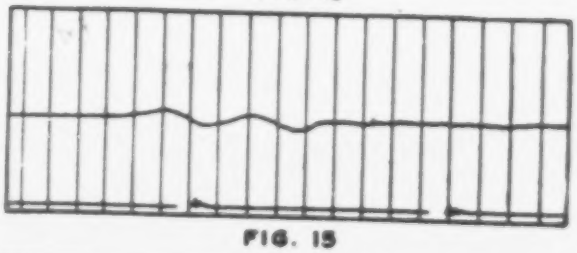


FIG. 15

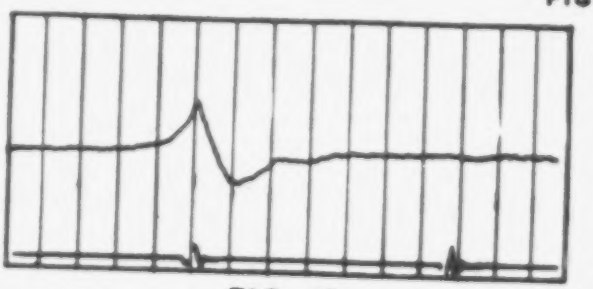


FIG. 16

FIGS. 12 TO 16. TYPICAL VELOCITY ACCELERATION DIAGRAMS

The induction stroke is seen halfway between the first misfire and the explosion. The ignition takes place only very slightly before explosion "in center," and the exhaust valve opening is very well marked.

This record was taken without the use of the auxiliary time record used to locate the position of the crankshaft. It is reproduced merely to show the character of a record taken with relatively great engine speeds. This record is not characteristic of an explosion of this engine since, owing to the misfire which preceded the explosion, the cylinder was "scavenged" for the particular explosion recorded. The ordinary, or non-scavenged, explosion of this engine at the same speed (a trace of which was obtained later on the same record) does not show so rapid a rise in pressure nor so quick an attainment of maximum pressure. A comparison of the records of scavenged and unscavenged explosions for this engine showed that in the former the maximum pressure was about 20 per cent greater than in the latter.

Figs. 15 and 16 show clearly the very marked difference in the character of the indicator diagram for the change from a very retarded spark (Fig. 15) to a very advanced spark (Fig. 16). Both records were obtained with a small four-cylinder Continental motor. Fig. 15, r.p.m. 700; maximum pressure 90 deg. after explosion in center. Fig. 16, r.p.m. 840; maximum pressure 20 deg. after explosion in center.

The great and long-sustained fall of pressure when the exhaust valve is opened after explosion with the retarded spark is well shown in Fig. 15. This should be compared with slight but well-marked indication of the exhaust-valve opening in the record of the explosion with advanced spark (Fig. 16). Figs. 12 to 16, inclusive, will serve to show the possibilities of an indicator of the type described, the deductions drawn being based on the study of many hundreds of original records which show details lost in the process of reproduction of the samples used to illustrate this article.

Note.—To illustrate the method of deriving one form of record from another let us assume that we possess a correct indicator diagram of the standard form and calculate the form that this diagram would assume if the co-ordinates, instead of being p and v were p and t; next, what the change of form of the diagram would be if the co-ordinates were changed to the rate of variation of p with the time $\frac{\delta p}{\delta t}$ and t. This is the form in which the diagram would be obtained with the par-

ticular indicator and recorder described in this article. The reverse steps to those which have just been outlined are the ones to be taken when it is desired to convert an experimental record with the co-ordinates $\frac{\Delta p}{\Delta t}$, t into the standard form of indicator diagram with the co-ordinates p, v.

Referring to the diagram, Fig. 6, curve *abcpdea* represents a typical indicator diagram in which the x co-ordinate represents the volume of cylinder and clearance volume for any position of the piston and the y co-ordinate represents the pressure which the gas exerts at any given volume. V_c is the clearance volume and V_m is the volume at the out center position of the piston. The dotted line *ab* represents the compression stroke. The full line *bcd* represents the expansion stroke to the point *d* at which the exhaust valve opens. The dotted line *ae* represents the scavenging stroke and the full line *ea* represents the induction stroke. The example chosen represents a cycle with a rather retarded spark.

To convert this diagram into its equivalent in which the time that has elapsed since the piston was at, say, explosion in center, is plotted along the axis of x instead of the volume as in Fig. 6, and in which, as before, the pressure is plotted along the axis of y, one has merely to divide the distance $V_c V_m$ into equal time intervals instead of equal volume intervals as in Fig. 6. This may either be done accurately from measurements on the engine under test or with an accuracy sufficient for most purposes on the assumption that the piston executes simple harmonic motion when the crankshaft revolves with uniform speed. In this case the time at which the piston is in any position represented by p in Fig. 6 is given by the expression $V_t = \frac{V_m + V_c}{2} - \frac{V_m - V_c}{2} \cos\left(2\pi \frac{t}{T}\right)$, where T is the time in seconds of one rotation of the crankshaft and t is the time that has elapsed since the piston was at the explosion in center. In either case the pressure-time diagram has the form of the curve represented in Fig. 7.

The time rate of variation of the pressure $\left(\frac{\Delta p}{\Delta t}\right)$ is represented by the tangent of the angle of the slope of the curve of Fig. 6; that is, wherever the curve of Fig. 7 has a maximum or minimum value, $\frac{\Delta p}{\Delta t}$ is zero as shown in the curve of Fig. 8 at the points above *b*, *c*, etc.; wherever the curve of Fig. 7 has the greatest slope up, there is a positive maximum to the curve of Fig. 8, and where the slope is greatest downward there is a negative maximum to the curve of Fig. 8. One of the properties of this curve is that the total area of the negative loops must equal the total area of the positive loops for a complete cycle, say from $t = o$ to $t = T$, or so any area between two given ordinates $t = t_1$ and $t = t_2$ is proportional to the difference of the pressures $(p_2 - p_1)$, which are represented by the curves of Fig. 6 at the two times.*

Since for a complete cycle the initial and final pressures are the same, the positive and negative areas of the curve of Fig. 8 must be equal. The recording instrument described in this article furnishes indicator diagrams of the type of the curve of Fig. 8, and the theoretical properties of the curve just discussed furnish a valuable check on the performance in practice of the indicator. It should be noted that this is a decided advantage of this form of diagram as no such severe test of the accuracy of the indicator exists for the case of the standard form of indicator giving a diagram of the form of the curve in Fig. 6.

It should be further noted by comparison of the curves of Figs. 6 and 8 that the position of the crankshaft when a valve opens or when the spark occurs may be much more accurately located from a diagram similar to curve 8 than it is from one similar to curve 6 (this will be apparent by comparing the various curves at the points *d*, *b* and *c*). In general, when a change of slope occurs in curve 6, there appears a much more marked feature in the curve 8, and this permits a much more accurate "timing" of the occurrence.

*This follows since the area is given by

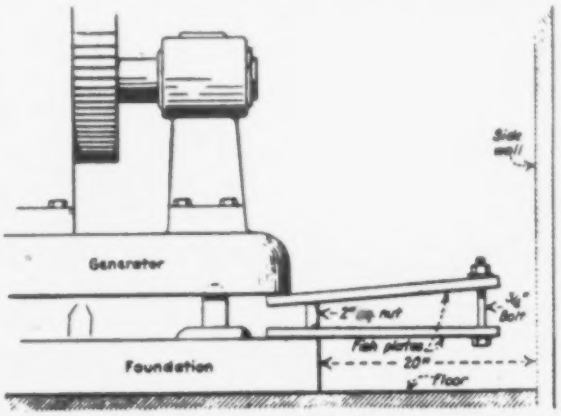
$$\int_{t=t_1}^{t=t_2} \frac{\Delta p}{\Delta t}\, dt = k\,(p_2 - p_1)$$

where k is a constant dependent on the scale of the drawing.

Handy Lifting Jack

BY O. B. CRITCHLOW

It was necessary to raise one side of a 125-kw. belted alternator in order to shim up the tightener rail, as the machine had settled. This machine was crowded into a corner as close as it was possible to get it, and



FISHPLATE LIFT JACK FOR RAISING ALTERNATOR

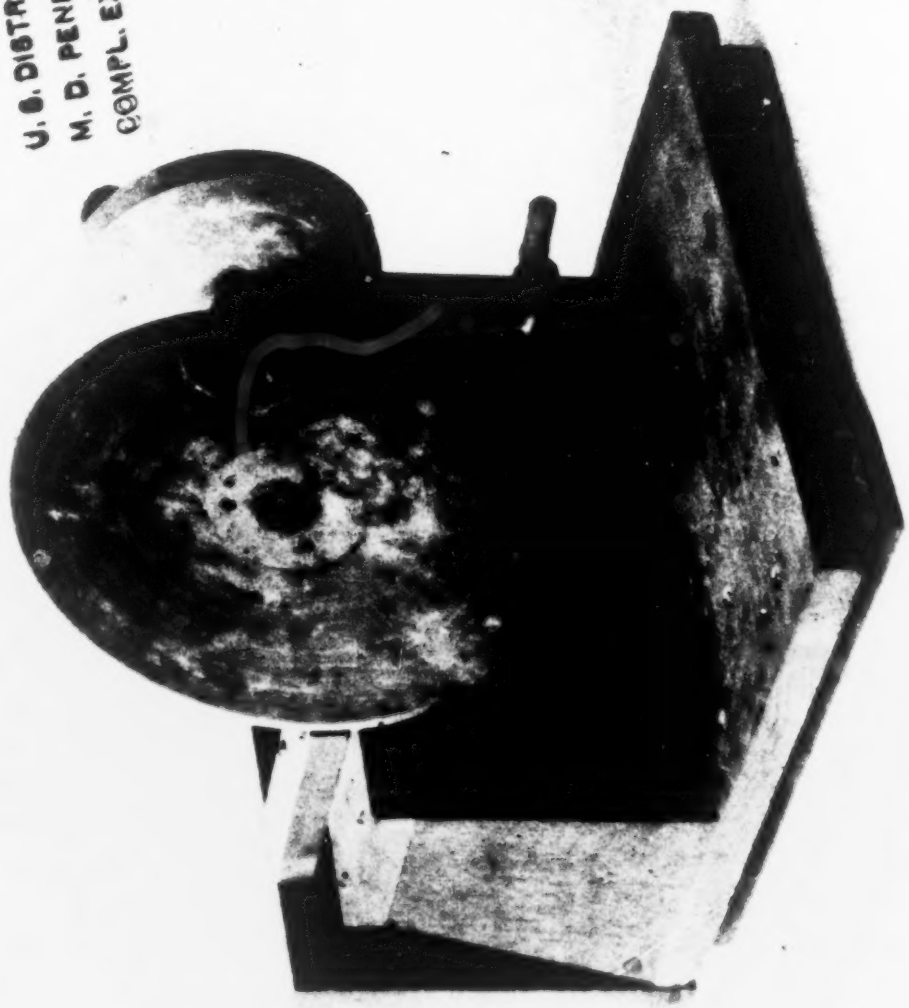
the end next to the side wall had to be raised. It might have been possible to make the lift with a small foot jack, but none was available and to use a lever was out of the question. The accompanying sketch shows the method employed by a machinist friend who was assisting the writer.

The materials used in this case were obtained from a near-by railroad scrap pile and consisted of two fishplates, a nut from a 2-in. bolt and a ¾-in. bolt with 8" long thread and a nut to correspond.

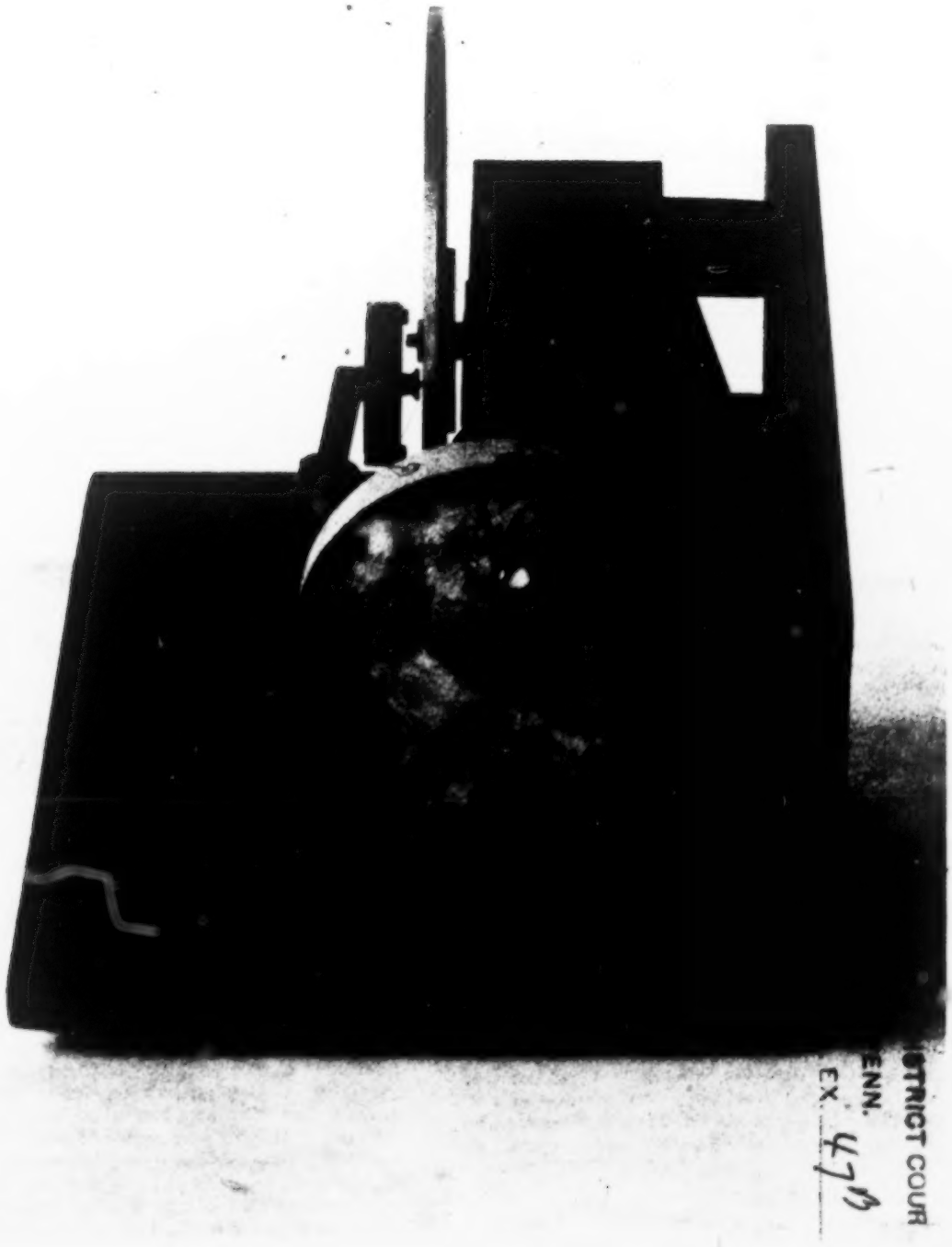
In a primary or common battery, the positive terminal of the battery is attached to the negative element and the negative terminal to the positive element. This should not cause confusion, for electricity must always flow from positive to negative, therefore from the positive to the negative terminal of the outside circuit, and from the positive to the negative element inside the battery.

PLAINTIFFS' EXHIBIT NO. 47-A.

U. S. DISTRICT COURT
M. D. PENN.
COMPL. EX. 47-a

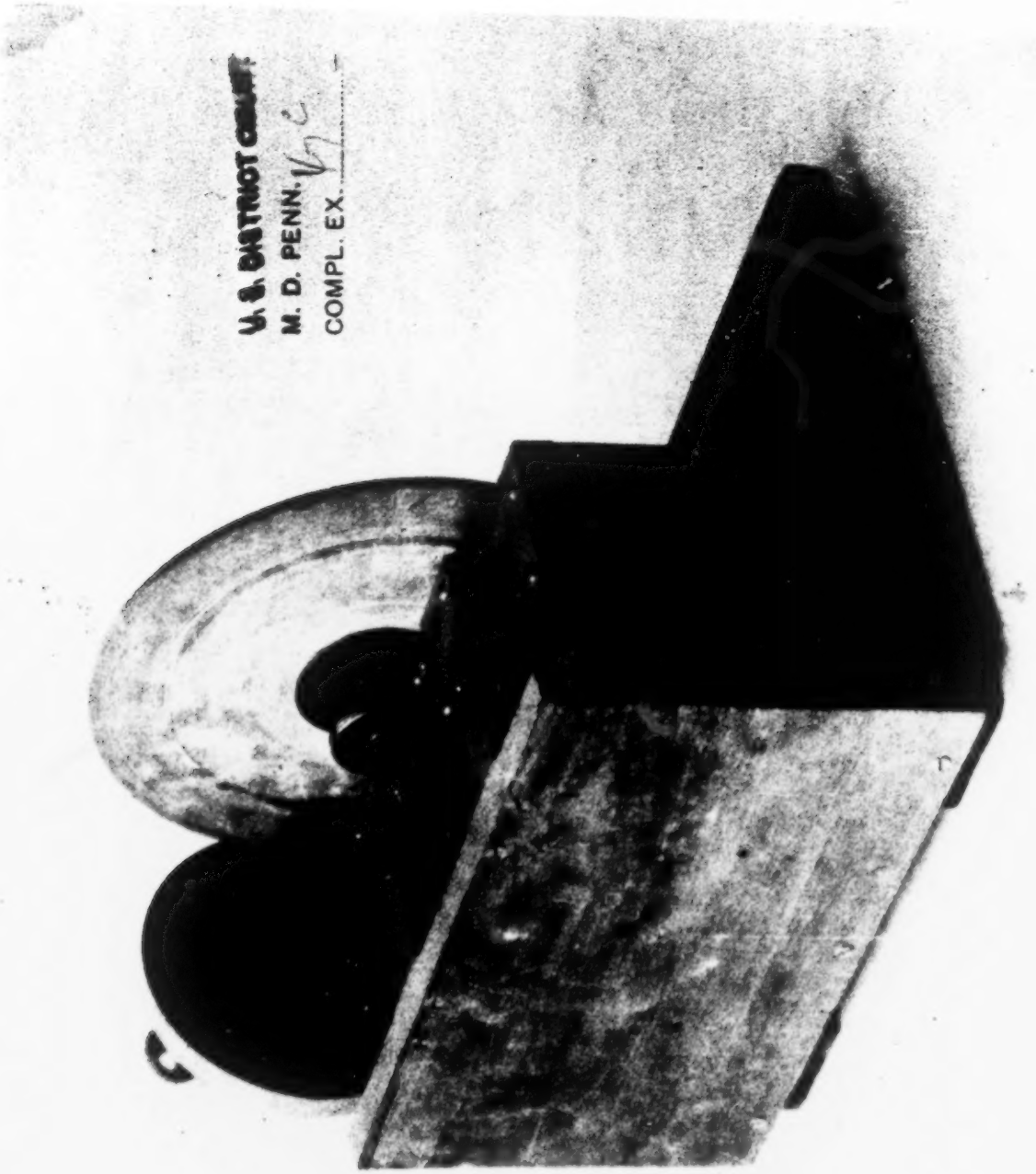


PLAINTIFFS' EXHIBIT NO. 47-B.



DISTRICT COUR
ENN.
EX. 47B

PLAINTIFFS' EXHIBIT NO. 47-C.



PLAINTIFFS' EXHIBIT NO. 48.

Der Lichtbildtheater-Besitzer,

No. 49, 1922,
pp. 6-9.

The Film as a Carrier of Sound Waves.

By Dr. Johannes Rolle,
Berlin.

Before the 19th ordinary meeting of the Deutsche Kinotechnische Gesellschaft (incorporated) held on the 19th of October at Berlin, Hans Vogt delivered his first lecture before an expert audience on the results of investigations made by him in collaboration with Josef Massolle and Dr. J. Engl beginning in 1918 in connection with the use of films as carriers of sound waves. The original intention was to publish in this periodical a connected description of all details of the long and thorny path the inventors had to cover, the aim of which, namely, a practically perfect recording and reproduction of all sound ranging between 50 and 20000 vibrations per second has now been realized. One unfortunate circumstance is that, because of the great importance and value of the fono-film problem several inventors or groups of inventors simultaneously and partly probably also in a duplicating way have been working on this subject, a number of disagreeable facts have arisen. For instance, in No. 43 of Elektrotechnische Zeitschrift an article has been published by a man who apparently is not thoroughly familiar with the situation in which an attempt is made to set forth the status of the acoustic film by the use of unproved and unprovable assertions, the author of the article even going to the length of totally ignoring Vogt and

his collaborators, who are the only ones having accomplished so far anything that is really practical, in order to deprive them of the credit they deserve for their work. On the other hand, an attempt was made at bribing one of the collaborators of the above inventors by a foreigner who seemingly disposes of far more Dollars than inventive ideas.

In the light of this situation, publication of the finished manuscript will have to deferred until even the last delicate features have been definitely protected and defined by patent. Since some time may pass until this is possible, we shall for the time being set forth and show by the aid of a number of illustrations and data used by Mr. Vogt in his lecture in what way the three inventors have succeeded in making a film the vehicle or carrier of sound waves or sound-wave records, or in creating, to use their own words, the Tri-ergon acoustic film.

There were two primary difficulties which had to be overcome in order to successfully solve the above problem, to wit:

(1) the detrimental and disturbing natural periods, inertia phenomena, and resonance actions of acoustic, mechanical, and electrical transmission means, and

(2) the extremely small quantities of energy inherent in sound, from a mechanical viewpoint.

All of the arrangements and devices heretofore utilized for the recording and reproducing of sound, whether mechanical in nature like oscillating diaphragms, pins, mirrors, or acoustic devices, vibrating air columns and horns, or even electrical oscillation circuits, magnetic fields or the microphone, exhibit actions of the kind set forth in (1). These, in the first place, distort sound in such a manner that reproduc-

tion is only a weak, shallow, hardly recognizable noise instead of a well modulated harmonious sound originally produced (canned music). Another point is—and this is almost worse than the other—:all of the transmission means amplify the reproduced sound waves in an entirely disproportionate way as soon as their frequency happens to be in tune with the period of the transmitting system, or a particularly predominant part of this system. This is a phenomenon which one may observe in every telephone receiver and every talking machine, especially those of the horn-equipped type. These apparatus seem to exhibit a selective action in the case of certain pitches, so that while the sound is normally given off "piano", they reproduce such selective pitches with an energy that seems incomprehensible at the first moment, indeed, the whole apparatus appears to quiver with internal excitement, as it were, and partakes of the vibrations (natural period).

Another fact is that mechanical sound reproduction, similarly, as transmission by the telephone, is mostly associated with rattling, howling, frying, and screatching noises, or strange curiously howling noises admix to the conversation. All of these phenomena are due to the imperfections of the microphone, impurities in the diaphragm or induction in the telephone circuits.

In order that all of these disturbances may be precluded from the outset, starting from the principle underlying the Ruhmer photophone, Vogt and his associates were the first to employ exclusively inertialess transmitter means free from natural periods, and they eliminated all induction effects. In what way the problem was solved in detail shall be shown further below.

The second serious difficulty attendant upon sound recording, namely, the fact that the sound contains only extremely small mechanical energies, was overcome by an ingenious amplifier system which resembles the

similar devices used in radio-telegraphy, though the same comprises some novel specially designed thermionic tubes and novel circuit arrangements. If it is kept in mind that the mechanical energy in sound, for instance, as given off by the human voice amounts to only 1000 milliardths (billionths) of the electrical energy contained in a pocket-lamp battery, it will be easy to get an idea as to how much amplification is required in order that the oscillations in a sound-filled room may be converted into luminous vibrations of an electric lamp which, in turn, causes more or less intense light impressions upon a travelling film strip. And amplification had to be very uniform throughout the whole compass or range of vibrations in question, say, between 50 and 20000 per second. Amplification of only selected groups of sound had to be carefully avoided.

Now, how were these problems solved in practice? The problem of the fono-film is divided into three stages, i. e., the recording, the negative and positive process, and reproduction.

(A). Recording.—The final result of the recording process is a strip of negative film which contiguous to each other, though still undeveloped, carries the light impressions of the scene or picture and those of the sound. Fig. 1 shows a diagram of the equipment adapted to picture and fono-film recording. On top, at the right-hand side, we note the feed spool, on the right below the spool on which the film is wound. The film travels by intermittent motion from the top in downward direction, first passes the picture-taking apparatus B so as to receive light impressions from the objective I during the short intermissions when the film is stationary. Then it travels through a loop and assumes a uniform, perfectly uniform, motion, and while traveling past, it is illuminated in the sound-recorder apparatus T opposite a small slit, and these

light impressions vibrate at the rate and rhythm of the tonal vibrations.

Now, these vibrations of the light which, unimpeded by any inert or sluggish masses and undisturbed by any natural periods, are to reflect in perfect purity all delicate and fine shadings of the sound being recorded, are obtained in the following manner:

(1). The Kathodophone.—On the left-hand side in Fig. 1, we see a funnel or mouthpiece marked "Sound" (Schall) whence a wire is brought to a larger rectangle marked "Verstärker I" (amplifier I). The second wire belonging to the first is united with the small rectangle connected with amplifier I on the left, so that there is a potential between the mouthpiece and the said small rectangle. The small rectangle in reality consists of the glower of a Nernst lamp (Fig. 2) opposite which, at a very definite small distance, the nozzle of the mouthpiece is disposed. Between the two there exists a pd, which, as soon as the gas particles in the neighborhood of the Nernst rod have been ionized by thermal action, results in a discharge gap. Now, the resistance of this discharge gap changes with the vibrations of the inertialess ionized gas particles set into movement by the sound, and these extremely feeble pd's are undistortedly amplified by the amplifier I comprising a plurality of thermionic tubes to a point where they cause the light of the recording lamp to go through luminous variations corresponding exactly to the tonal vibrations.

(2). The recording lamp.—Also for this device, of course, only an inertialess element for transmission may be used. Metal-filament lamps whose filament, on account of its thermal capacity, is not in a position to follow and respond to current variations occurring inside fractions of tenthousandths of a second, are

unserviceable as recording means. For this reason, glow-discharge lamps (Glim-lamps) of the kind resembling Geisler tubes are used in which rarefied gases are caused to luminesce and which represent a perfectly inertialess light source.

The light of the recorder lamp is concentrated through a lens system upon an extremely narrow slip in the rear of which the film strip is made to travel at a uniform rate of speed.

This would finish the recording work. In reality, however, the matter is not quite as simple in operation as has here been described. We may only recall the typical burring noise of the crank box, the rattle of the grippers, the hissing and sizzling of the film at the slide bars and the tooth drums. All of these extraneous noises as well as that of the electric motor used for drive (for only motor drive may be resorted to for reasons of the indispensable uniformity of running) must be carefully precluded, or, in so far as this is not necessary, must be kept away by suitable damping, absorbing and insulating means from the ear of the recording apparatus, the mouthpiece, and from the discharge gap. Also other stray noises such as the hissing of lamps in the studio and reverberation or echo of sound being recorded should be limited by suitable means.

(B). Negative and positive process.—This proceeds in very much the same way as in the case of the ordinary movie film. The film strip, which, as can be seen from Fig. 3, is about 7 mm wider than the standard film strip since it bears on one side a strip for the acoustic impressions alongside the perforations, is developed, and multiplied in a copying machine of special design so as to insure absolutely uniform running (synchronism). Under practical conditions, it has been found convenient to "crank" a second negative

and to copy this upon the positive instead of the original. The underlying reason is that occasionally the work of taking the picture requires another treatment during the developing process than the acoustic film. The copy is finished in the customary way. Cemented places and joints, of course, should be carefully avoided. But above all care should be taken so that the acoustic film strip is developed as uniformly as possible, for it is in these fine, changing and perfectly harmless looking transversal lines, that all of the beauty of the human voice, the melodiousness of the violine, the first babble of the child and the noise of the breakers of the sea, are contained, so that it would be a pity if by inexpert treatment and handling the film all the work connected with the recording would go to waste.

(C). Reproduction.—The upper part of the diagrammatic picture shown in Fig. 4 of a fono-foto-film reproducing equipment probably will be readily understood. It is nothing else than a projector machine as used in the movies involving an intermittently travelling picture film, or else, if a machine furnished with optical balancing means is at disposal, with an uninterrupted film strip. But the lower half of the picture contains a number of interesting features. Luminous source II being a metal-filament lamp or a Nernst lamp, throws its light through a condensing lens upon the film which passes at this point at a uniform rate, presenting a very small slit. In the rear of the said fine slit is the "eye" of the apparatus, the photo-electric cell.

(3). The Photo-electric cell.—This peculiar element shown in Fig. 5 is an exhaust glass bulb filled with argon, one half of the bulb being interiorly coated with alkali metal, and opposite this coat, and in the middle

of the bulb, is a wire loop which constitutes the other pole of a discharge gap. As soon as a luminous ray strikes this cell, the resistance of the latter undergoes an alteration similarly as in the selenium cell. However, the great difference compared with the latter resides in that the photo-electric cell works under conditions of perfect freedom from inertia so that it is infinitely more suited for fono-film work and reproduction.

As the film is caused to travel past, light and dark varies in the photo-electric cell in all imaginable graduations, and this tonal script, as it may be called translated into current variations is again fed to an amplifier which intensifies the same into powerful currents under conditions free from distortion and perfect preservation of its distinctive characteristics.

(4). The Statophone.—If these current variations were to be converted into sound by the aid of an electromagnetic telephone or an apparatus patterned along the same lines, all of the inventive effort so far put forth would come to nought, and only the rattling, tinny noise bare of any distinctive characteristics as found in the telephone receiver would be obtained. For this reason, the electromagnetic principle was discarded, and the Statophone predicated upon static electricity was evolved (Fig. 6). It consists of a specially prepared metal plate which is connected with the positive pole of the amplifier. Upon this plate, and separated therefrom only by a thin insulating film, is a thin metal foil which is united with the negative pole. The attraction between both metal coats changes at the same rhythm or rate and to the same extent, as the current variations coming from the photo-electric cell and raised by the amplifier to a very high potential. In this way, clear notes undisturbed by natural

periods are obtained, and these equal those of the original source in every respect.

Practical reproduction is effected in this manner that the reproducer apparatus (Fig. 8) is mounted in the rear of the audience and works "projector-fashion". Several statophones are mounted below or on the side of the picture screen, and they fill the room with a powerful and distinct reproduction of the notes, tones, or noises which occurred or were produced during the taking of the picture.

Of course, on account of the fact that the picture and sound points in the reproducing apparatus are located just as far apart as during recording, absolutely perfect synchronism is insured. It will be understood that the Triergon fono-film could just as readily be used for the operation of gramophone-like talking machines using films in lieu of disks. It may furthermore be mentioned that by the direct combination of cathadophone and statophone with telephone wires or wireless spark-gaps and amplifiers a telephone equipment may be created which is suited for the direct transmission of music, with complete preservation of the beauty and melodious characteristics of the sound.

This is not the place to go into a discussion of the "pro and con" of the remarks on the part of the film critics, dramaturges, and apostles of aesthetics respecting the first public performances of the Triergon fono-film. Each one of them may be right in his own way, and in the last analysis it can be only shown by and in the future in what way the production of films and the moving-picture industry will be affected by the new invention. All the writer wanted to do in this place, as a matter of fulfilling an act of duty, was to stress the great and able work done by the three men Vogt, Dr. Engl and Massolle during this none too appropriate period. And I believe I may conclude this survey in

no better way than by expressing the same wish which Mr. Vogt voiced at the end of his lecture for the child of his intellectual effort:

"Let us wish that the improved film strip which may be called upon to impress a different feature upon cinematography, may find men with an artistic conscience so that it may not only become a beautifier of our hours of leizure, but also an intermediator of real cultural and life values."

With seven illustrations.

Ein altes und auch richtiges Wort sagt aber: Wo ein Wille ist, da ist auch ein Weg. Es wäre tieftraurig, wenn diese Volksweisheit sich nicht endlich Geltung verschaffen könnte. Es ist ja schon wiederholt darauf hingewiesen worden, daß gerade innerhalb der Filmbranche die Interessen parallel laufen, daß sie aus einer gemeinsamen Quelle entspringen und einem gemeinsamen Ziele zustreben. Dieser Umstand ist wie ein tröstliches Licht im Dunkel der Ereignisse und es heißt nur diesen Schimmer nicht aus dem Auge zu lassen, damit die Einzelnen nicht den Pfad verlieren und in die Irre gehen.

Denn dunkel und trübe sind die Zeiten. Der helle Glanz der Weihnachtskerzen strahlt nicht mehr wie einst. Von den tausenden und abertausenden von Lichtlein sind viele erloschen, denn wir sind zu arm geworden, um unser Heim zu erleuchten und zu erwärmen. Oede, trostlos und kalt ist es in gar vielen Häusern und da sollen wir um so mehr darauf bedacht sein, daß diese Oede und Trostlosigkeit, daß diese Kälte nicht auch von unseren Herzen Besitz ergreife, alle unsere Empfindungen verdunkele, sie erkalten und erstarren lassen. Der krasse Egoismus der scheinbar alle Beziehungen der Menschen untereinander so sehr materialistisch beeinflußt, er darf sich nicht zum Alleinherrscher aufwerfen; es muß auch der Altruismus zu seinem Rechte kommen, die Menschen müssen wieder denken lernen, daß man nicht nur für sich selbst, sondern auch für den Nächsten auf der Welt ist und daß man das eigene Wohl nicht rücksichtslos dem Anderen gegenüber zur Geltung bringen dürfe.

Wer ist so verknöchert, daß er nicht beim Klang der Weihnachtsglocken von Gedanken und Gefühlen bewegt werde, die sonst während des ganzen Jahres in der Hast des Daseinskampfes stumm geblieben sind? Wer hätte nicht noch in einem wenn auch versteckten Winkel seines Herzens ein kleines, ein winziges Fleckchen, das noch durchpulst ist, von dem warmen Blutstrom der Liebe, des Mitleids, der Mitfreude? Wer hätte nicht noch etwas aus seiner Kindheit Tage herübergerettet für die Stunde, in der sich die Lichter des Weihnachtsbaumes entzünden?

Wohl dem, bei dem dies noch zutrifft — wehe dem, der sich nichts, aber auch gar nichts aus dem Märchenlande des Idealismus hinüberzuretten vermocht hat in die öde materialistische Wüste, in die sich die Menschheit nicht durch den Willen Gottes, sondern durch eigenen Willen verbannt hat.

In den Lichtspieltheatern steht wohl überall ein Weihnachtsbaum, festlich geschmückt, in reichem Lichterglanz. Wer denkt daran, welch eine Wohltat das für alle diejenigen bedeutet, die heute nicht mehr in der Lage sind, sich und ihren Kindern einen eigenen Baum zu schmücken und zum Erstrahlen zu bringen? Vielleicht zu keiner Zeit kommt es so deutlich zum Bewußtsein, was das Lichtspieltheater für die nicht mit Glücksgütern Gesegneten bedeutet. Wieviele Kinder müßten gänzlich auf den Anblick eines Weihnachtsbaums verzichten, würden überhaupt nichts von Weihnachtsstimmung haben, gäbe ihnen nicht die Weihnachtsvorstellung im Lichtspieltheater einen Ersatz.

Daran mögen alle diejenigen denken, die sich heute noch vielleicht als Gegner des Kinos bekennen. Sie mögen sich all die Tausende fröhlicher Kinder vergegenwärtigen, die sich in der Weihnachtszeit bei den Jugendvorstellungen zusammenfinden und mit leuchtenden Augen und strahlenden Gesichtern auf den mehr oder weniger prächtig geschmückten Baum sehen und dankbar die kleinen Gaben in Empfang nehmen, die noch mancher besonders freigebige Theaterbesitzer verteilt.

Wir gehen einem neuen Jahr entgegen — wir wissen nicht, was es bringen wird. Wir geben uns aber der Hoffnung hin, daß das diesjährige Weihnachtsfest die Menschen wird nachdenken lassen über den großen Schaden, den ein ungezügelter Egoismus in allen Menschenherzen anrichten muß, über den großen Zwiespalt, der die Menschen zur Trennung führt, zum Kampfe, statt zur Einigkeit und gegenseitiger Liebe.

Darum sei die Mahnung ausgesprochen: Hört was die Weihnachtsglocken singen und klingen: Friede den Menschen auf Erden — allen, die eines guten Willens sind! Friede und fröhliches Fest!

J. M. M-ich.

Der Film als Träger von Schallwellen

Von Dr. Johannes Rolle, D. K. G., Berlin.

Am 19. Oktober d. J. berichtete Hans Vogt in der 19. ordentlichen Sitzung der „Deutschen Kinotechnischen Gesellschaft (E. V.) zu Berlin zum erstenmal vor einem sachkundigen Hörerkreis über das Ergebnis der Versuchsarbeiten, die er gemeinsam mit Josef Massolle und Dr. J. Engl seit dem Jahr 1918 über die Verwendung von Filmbändern als Träger von Schallwellen durchgeführt hat. Es bestand ursprünglich die Absicht, in dieser Zeitschrift eine zusammenhängende Darstellung aller Einzelheiten des langen und mühseligen Erfindungsweges zu geben, dessen Ziel, die praktisch einwandfreie, mit völliger Sicherheit gelingende Aufnahme und Wiedergabe eines jeden Schalles von 50 bis 20 000 Schwingungen in der Sekunde, nunmehr erreicht ist. Leider hat der Umstand, daß in Anbetracht der großen Bedeutung des Schallfilmproblems mehrere Erfinder oder Erfindergruppen gleichzeitig und zum Teil wohl auch gleichlaufend miteinander gearbeitet haben, einige höchst unerfreuliche Erscheinungen gezeitigt. Diese bestehen einmal in einem Aufsatz in Nr. 43 der „Elektrotechnischen Zeitschrift", woselbst ein offenbar mit der Sachlage nicht ganz vertrauter Verfasser den Versuch unternimmt, den gegenwärtigen Stand der Frage des tönenden Films durch unbewiesene und unbeweisbare Behauptungen zu kennzeichen, wobei er es fertigbringt, Vogt und seine Mitarbeiter, die einzigen, die bisher auf diesem Gebiet etwas praktisch Vollkommenes geleistet haben, totzuschweigen, um sie auf diese Weise um ihren Erfinderruhm zu bringen. Andererseits wurde von einem valutastarken Ausländer, der anscheinend über mehr Dollars als Erfindungsgedanken verfügt, ein Bestechungsversuch an einem technischen Mitarbeiter der genannten Herren unternommen.

Unter diesen Verhältnissen muß die Veröffentlichung des bereits fertiggestellten Manuskriptes so lange unterbleiben, bis auch die letzten Feinheiten der neuen Arbeitsweise

patentrechtlich endgültig festgelegt und geschützt sind. Da bis dahin noch einige Zeit vergehen dürfte, wollen wir einstweilen an Hand einiger Abbildungen und der Aufzeichnungen, deren sich Herr Vogt bei seinem Vortrag bediente, zeigen, in welcher Weise es den drei Erfindern gelungen ist, den Film zum Träger von Schallwellen zu machen oder, wie sie sich selbst ausdrücken, den Tri-ergon- (das Werk der Drei) Tonfilm, zu schaffen.

Zwei Schwierigkeiten waren es in erster Linie, die sich dem Gelingen der oben bezeichneten Aufgabe entgegenstellten:

1. Die störenden Eigenschwingungen, Trägheitserscheinungen und Resonanzlagen der akustischen, mechanischen und elektrischen Uebertragungsmittel;

2. die außerordentlich geringen mechanischen Energiemengen, die dem Schall innewohnen.

Alle bisher zur Aufnahme und Wiedergabe von Tönen benutzten Vorrichtungen, ob sie sich nun mechanischer Mittel wie schwingender Membranen, Stifte, Spiegel oder akustischer Vorrichtungen, schwingender Luftsäulen und Schalltrichtern oder selbst elektrischer Schwingungskreise, magnetischer Felder oder des Mikrophons bedienen, weisen die unter 1 genannten Erscheinungen auf. Diese entstellen einmal den Ton derart, daß die Wiedergabe nur ein mattes, schales, kaum wiederzuerkennendes Geräusch anstatt des kräftigen Wohllautes des ursprünglichen Tones zeigt (Konservenmusik). Dann aber, und das ist fast noch schlimmer, verstärken all diese Uebertragungsmittel die wiedergegebenen Tonschwingungen in ganz ungeheuerlichem Maße, soweit deren Schwingungszahl sich mit der Schwingungszahl des übertragenden Systems oder eines besonders vorherrschenden Teils dieses Systems deckt. Das ist eine Erscheinung, die wir fast an jedem Fernsprecher und an jeder Sprechmaschine, besonders an solchen, die mit Schalltrichter versehen sind, wahrnehmen können. Die Apparate scheinen gewisse Tonlagen zu bevorzugen und schmettern im Gegensatz zu dem sonstigen Piano diese Töne mit einer im ersten Augenblick ganz unverständlichen kreischenden Energie heraus, wobei vielfach der ganze Apparat anscheinend vor innerer Aufregung erzittert und mitschwingt (Eigenschwingung).

Außerdem ist die mechanische Tonwiedergabe ebenso wie die Uebertragung durch den Fernsprecher meist mit einem Knattern, Rauschen, Sausen, Knistern verbunden, oder es mischen sich seltsam heulende Töne in das Gespräch. Diese Erscheinungen sind durch die Unvollkommenheiten des Mikrophons, die Unreinheiten der Schallplatte oder durch Induktionserscheinungen in den Fernsprechleitungen bedingt.

Um all diese Störungen von vornherein grundsätzlich auszuschließen, verwandten Vogt und Genossen, ausgehend von dem Prinzip des Ruhmerschen Photophons, als erste durchweg nur trägheitslose Uebertragungsmittel ohne Eigenschwingungen und schlossen alle störenden Induktionserscheinungen aus. Wie diese Aufgabe im einzelnen gelöst wurde, soll weiter unten gezeigt werden.

Die zweite große Schwierigkeit der Schallaufnahme, nämlich der Umstand, daß dem Schall nur äußerst geringe mechanische Energiemengen innewohnen, wurde durch ein sinnreiches Verstärkersystem, das den entsprechenden Vorrichtungen der Funkentelegraphie ähnelt, aber sich neuer, besonders konstruierter Kathodenröhren und neuer Schaltungen bedient, überwunden. Wenn man sich vergegenwärtigt, daß die mechanische Energie des Schalles einer menschlichen Sprechstimme nur etwa 1000 Milliardsteln der elektrischen Energie einer Taschenlampenbatterie entspricht, so vermag man sich leicht einen Begriff der Verstärkung zu machen, die erforderlich war, um die Schwingungen der vom Klang erfüllten Luft in Lichtschwingungen einer elektrischen Lampe umzusetzen, die ihrerseits wieder auf einem vorübergleitenden Filmband stärkere und schwächere Lichteindrücke hervorrufen. Und dabei mußte die Verstärkung sich ganz gleichförmig über die gesamte Skala der hier in Betracht kommenden Schwingungen, die, wie eingangs bemerkt, von 30 Luftstößen in der Sekunde bis zu 20000 reicht, erstrecken. Jede Verstärkung nur einzelner Lautgruppen, jede selektive Verstärkung mußte peinlich vermieden werden.

Wie wurden nun diese sämtlichen Aufgaben praktisch gelöst?

Das Schallfilmproblem zerfällt in drei Arbeitsgebiete: die Aufnahme, den Negativ- und Positivprozeß und die Wiedergabe.

A. Die Aufnahme. Das Endergebnis des Aufnahmeverfahrens ist ein Streifen Negativfilm, der nebeneinander, noch unentwickelt, die Lichteindrücke des Szenenbildes und des Schalles trägt. In Abbildung 1 ist das Schema der Bildtonfilm-Aufnahme wiedergegeben. Wir sehen oben rechts die Vorratsspule, unten rechts die Aufwickelspule für den Film. Das Filmband läuft von oben nach unten, passiert zuerst in ruckweiser Bewegung den Bildaufnahmeapparat B, um hier während des jeweiligen Stillstandes die Lichteindrücke von dem Objektiv I her zu empfangen. Dann geht es über eine Schleife wieder in gleichförmige, in durchaus gleichförmige Bewegung über und wird in dem Tonaufnahmeapparat T während des Vorübergleitens an einer schmalen Schlitzblende mit den Lichteindrücken bestrahlt, welche im Rhythmus der Tonschwingungen vibrieren.

Diese Vibrationen des Lichtes, die ungehemmt durch irgendwelche träge Materie, ungestört durch irgendwelche Eigenschwingungen in vollster Reinheit alle feinen und feinsten Schattierungen des zur Aufnahme gelangenden Schalles wiederspiegeln müssen, kommen auf folgende Weise zustande:

1. Das Kathodophon. In Abbildung 1 sehen wir rechts einen mit „Schall" bezeichneten Trichter, von dem aus eine Leitung zu dem mit „Verstärker I" bezeichneten größeren Rechteck führt. Die zu der ersten gehörende zweite Leitung ist an das schmale, links vom Verstärker I dargestellte kleine Rechteck gelegt, so daß zwischen dem Trichter und

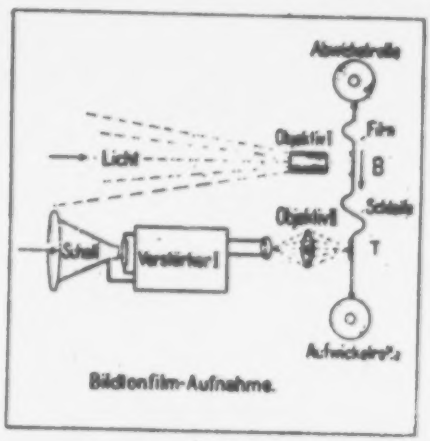


Abb. 1

dem kleinen Rechteck eine Spannung besteht. Das kleine Rechteck ist in Wirklichkeit der Glühkörper einer Nernstlampe (Abb. 2), dem gegenüber in einem ganz bestimmten geringen Abstand die Düse des Schalltrichters angeordnet ist. Zwischen beiden besteht eine elektrische Potentialdifferenz, die, sobald die Gasteilchen in der Umgebung des Nernststiftes infolge der Hitze jonisiert sind, eine Entladungsstrecke ergibt. Der Widerstand dieser Entladungsstrecke wechselt nun mit den Schwingungen der durch den Schall bewegten trägheitslosen jonisierten Gasteilchen, und diese äußerst geringen Spannungsdifferenzen werden durch den mit mehreren Kathodenröhren arbeitenden Verstärker I unverzerrt soweit verstärkt, daß sie das Licht der Aufzeichnungslampe in die den Tonschwingungen haargenau entsprechenden Lichtschwingungen versetzen.

2. Die Aufzeichnungslampe. Auch hier kommt selbstverständlich nur ein trägheitsloses Uebermittlungsorgan in Frage. Metallfadenlampen, deren Faden infolge seiner Wärmekapazität nicht in der Lage ist, Stromschwankungen, die in Bruchteilen von Zehntausendstelsekunden verlaufen, wiederzugeben, sind als Aufzeichnungslampe unbrauchbar. Man verwendet daher Glimmlampen nach der Art der Geislerröhren, in denen verdünnte Gase zum Aufleuchten gebracht werden und die eine vollkommen trägheitslose Lichtquelle darstellen.

Das Licht der Aufzeichnungslampe wird durch ein Linsensystem auf den äußerst schmalen Spalt vereinigt, hinter dem das Filmband in sich stets gleichbleibender Geschwindigkeit vorübergleitet.

Damit wäre die Aufnahme erledigt, die sich allerdings in der rauhen Wirklichkeit nicht ganz so einfach abspielt, wie

es hier beschrieben ist. Es sei nur an das bekannte Surren des Kurbelkastens, das Rattern des Greifers, das Zischen und Knistern des Films an den Gleitschienen und Zahntrommeln erinnert. All diese fremden Geräusche, ebenso wie das

Abb. 2. Kathodophon

Schnurren des zum Antrieb dienenden Elektromotors — hier kommt der Gleichmäßigkeit des Laufes wegen nur motorischer Antrieb in Frage — müssen sorgsam ausgeschaltet oder sofern dies nicht möglich ist, durch geeignete Dämpfungs- und Isolierungsvorrichtungen von dem Ohr des Aufnahmeapparates, dem Schalltrichter und der Entladungsstrecke ferngehalten werden. Außerdem sind alle sonstigen Nebengeräusche, das Zischen der etwa erforderlichen Atelierlampen sowie das Echo der zur Aufnahme gelangenden Töne durch entsprechende Maßnahmen zu beschränken.

B. Der Negativ- und Positivprozeß. Dieser vollzieht sich nicht viel anders als beim gewöhnlichen Kinofilm. Das Filmband, das, wie aus Abbildung 3 hervorgeht, um etwa 7 mm breiter als der normale Filmstreifen ist, da es auf der einen Seite neben der Perforation noch einen Streifen für die Tonaufnahme trägt, wird entwickelt und auf einer, des völlig gleichmäßigen Laufes wegen besonders konstruierten Kopiermaschine, vervielfältigt. In der Praxis hat es sich als zweckmäßig erwiesen, noch ein zweites Negativ zu drehen und dieses anstatt des Originals auf das Positiv zu kopieren. Der Grund liegt darin, daß bisweilen die Bildaufnahme eine andere entwickelungstechnische Behandlung erfordert als die Tonaufnahme. Die Kopie wird in der üblichen Weise fertiggestellt. Klebe- und Anstoßstellen sind natürlich sorgsam zu vermeiden. Vor allem aber ist darauf zu achten, daß der Tonstreifen möglichst gleichmäßig entwickelt wird, denn in den feinen, ineinander übergehenden und ganz harmlos und unscheinbar aussehenden Querlinien ist alle Schönheit der menschlichen Stimme ebenso wie der jubelnde Sang der Geigen, das erste Lallen eines Kindes wie das Rauschen der Meeresbrandung eingeschlossen, und es wäre schade, wenn durch unsachgemäße Behandlung des Films der große mit der Aufnahme verknüpfte Aufwand vernichtet würde.

C. Die Wiedergabe. Der obere Teil des in Abbildung 4 dargestellten Schemas der Bildtonfilm-Wiedergabe dürfte ohne weiteres verständlich sein. Es ist nichts anderes als eine gewöhnliche Kinoprojektion mit ruckweise bewegtem oder auch, wenn ein Apparat mit optischem Ausgleich zur Verfügung steht, mit ununterbrochen laufendem Bildband. Dagegen bietet die untere Hälfte des Schemas wieder allerhand Interessantes. Die Lichtquelle II, eine Metallfaden-

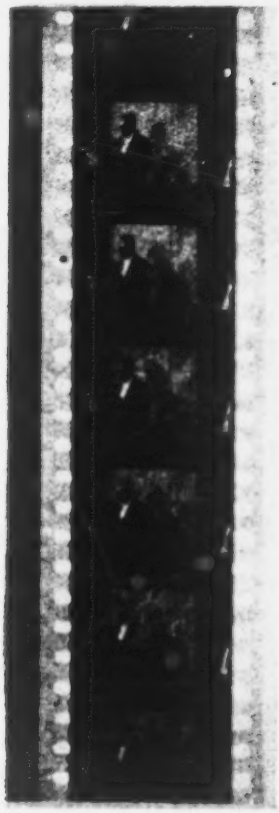


Abb. 3. Der Triergon-Tonfilm

oder Nernstlampe wirft ihr Licht durch den Kondensor II auf den Film, der an dieser Stelle an einer sehr schmalen Oeffnung gleichmäßig vorbeiläuft. Hinter diesem feinen Spalt liegt das Auge des Apparates, die Photozelle.

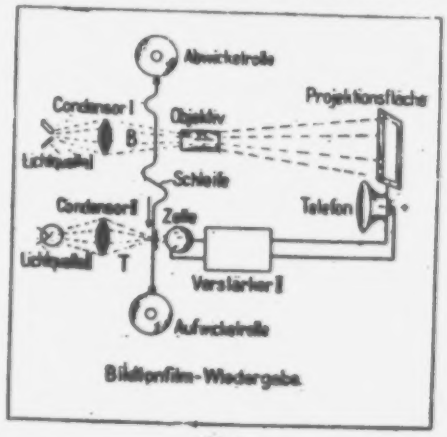


Abb. 4

3. Die Photozelle. Dieses aus Abbildung 5 näher ersichtliche eigenartige Organ ist eine luftleer gepumpte und

mit Argongas gefüllte Glasbirne, deren eine Hälfte mit einem Alkalimetall ausgekleidet ist, dem gegenüber im Mittelpunkt der Birne eine Drahtschleife angebracht ist, die den anderen Pol einer Entladungsstrecke bildet. Sobald auf diese Zelle ein Lichtstrahl trifft, ändert sich, ähnlich wie bei einer Seelenzelle der Widerstand der Zelle. Der große Unterschied aber

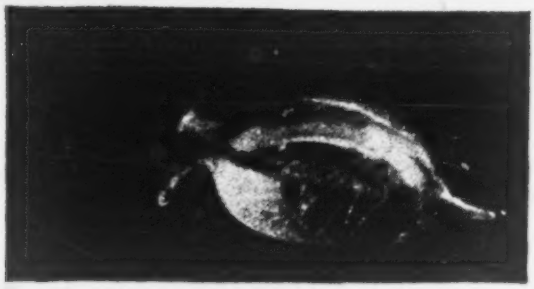


Abb. 5. Die Photozelle

besteht darin, daß die Photozelle vollkommen trägheitslos arbeitet und aus diesem Grunde für die Zwecke der Tonfilm-Wiedergabe unendlich viel geeigneter ist.

Im Vorübergleiten des Films wechselt in der Photozelle Hell und Dunkel in allen nur erdenklichen Abstufungen, und diese in Stromschwankungen übersetzte Tonschrift wird wiederum einem Verstärker zugeführt, der sie unter voller Wahrnehmung ihrer Eigenart ohne jegliche Verzerrung in kräftige Ströme umwandelt.

4. Das Statophon. Wollte man diese Stromschwingungen durch ein dem elektromagnetischen Telephon nachgebildetes Organ in Töne umsetzen, so würde man alle bis dahin aufgewandte Erfindungsarbeit zunichte machen und nur das schnarrende, blecherne, jeglicher Individualität bare Geräusch des Fernsprechers vernehmen. Deshalb wurde das elektromagnetische Prinzip verworfen und das auf statischer Elek-

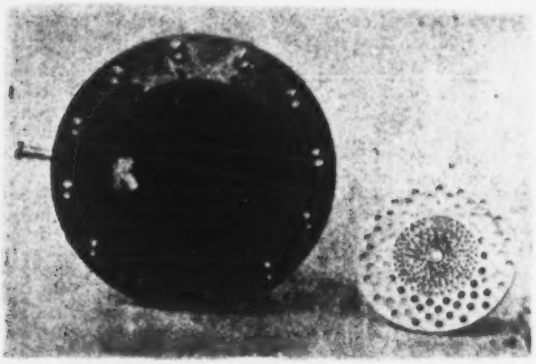


Abb. 6. Das Statophon

trizität beruhende Statophon gebaut (Abb. 6). Es besteht aus einer besonders präparierten Metallplatte, die mit dem positiven Pol des Verstärkers verbunden ist. Auf dieser Platte liegt, nur durch eine dünne isolierende Schicht getrennt, eine dünne Metallfolie, die an den negativen Pol angeschlossen ist. Die Anziehung zwischen beiden Metallschichten wechselt in dem gleichen Rhythmus und im gleichen Maß wie die von der Photozelle ausgehenden und von dem Verstärker auf sehr hohe Spannung gebrachten Stromschwingungen. Hierdurch werden klare, von keiner Eigenschwingung gestörte Töne hervorgebracht, die denen der Aufnahme in jeder Beziehung gleichen.

Die praktische Durchführung der Wiedergabe erfolgt in der Weise, daß der Wiedergabeapparat (Abb. 8) hinter den Zuschauern steht und in Aufprojektion arbeitet. Mehrere Statophone werden unter oder neben dem Bildschirm aufgestellt und erfüllen den Raum des Theaters mit einer kräftigen und deutlichen Wiedergabe der Töne, Laute oder Geräusche, die bei der im Bild gezeigten Szene erklangen.

Selbstverständlich ist dadurch, daß Bild- und Tonstelle im Wiedergabeapparat genau ebenso weit voneinander entfernt liegen wie bei der Aufnahme, ein völliges Zusammengehen von Bild und Ton, ein absoluter Synchronismus gewährleistet. Ebenso wie sich naturgemäß der Triergon-Tonfilm eben so gut zum Betrieb von grammophonartigen Sprechmaschinen, die statt mit Platten, mit Filmen arbeiten, verwenden läßt. Schließlich möge nicht unerwähnt bleiben, daß aus einer direkten Verbindung von Kathodophon und Statophon mit dazwischen angeordneten Fernsprechleitungen oder drahtlosen Funkenstrecken und Verstärkern ein Fernsprechgerät geschaffen wird, das zur direkten Uebermittlung von Musik bei voller Erhaltung der Schönheit und allen Wohllautes hervorragend geeignet ist.

Es ist hier nicht der Ort, das Für und Wider zu erwägen, das von seiten der Filmkritik, der Dramaturgen und Aestheten anläßlich der ersten öffentlichen Vorführungen des Triergontonfilms geltend gemacht wurde. Hier mag jeder auf seine Art recht haben, und letzten Endes wird erst die Zukunft zeigen, in welcher Weise Filmfabrikation und Kinowesen von der neuen Erfindung werden beeinflußt werden. Wir sind hier

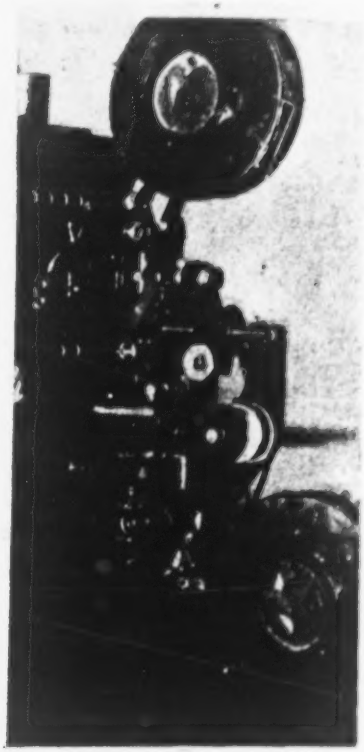


Abb. 7. Der Wiedergabeapparat

lediglich der Ehrenpflicht nachgekommen, die große und gediegene Erfinderarbeit zu würdigen, die von den drei Herren Vogt, Dr. Engl und Massolle in dieser wahrlich den deutschen Erfindern nicht gerade bequemen Zeit geleistet worden ist. Und wir glauben mit keinem besseren Wunsch schließen zu können, als dem, den Herr Vogt am Ende seines Vortrages seinem Geisteskind mit auf den Weg gab:

„Möge der verbesserte Filmstreifen, der vielleicht berufen ist, dem Kino ein anderes Gesicht zu geben, zu seiner Ausgestaltung Männer mit künstlerischem Gewissen finden und so nicht nur zu einem Verschönerer unserer Erholungsstunden, sondern auch zum Uebermittler wirklicher Kultur- und Lebenswerte sich entwickeln!"

PLAINTIFFS' EXHIBIT NO. 49.

United States Patent No. 1,758,832.

472

May 13, 1930. C. L. HEISLER 1,758,832

FILM DRIVING APPARATUS

Filed March 27, 1929

Fig. 1.

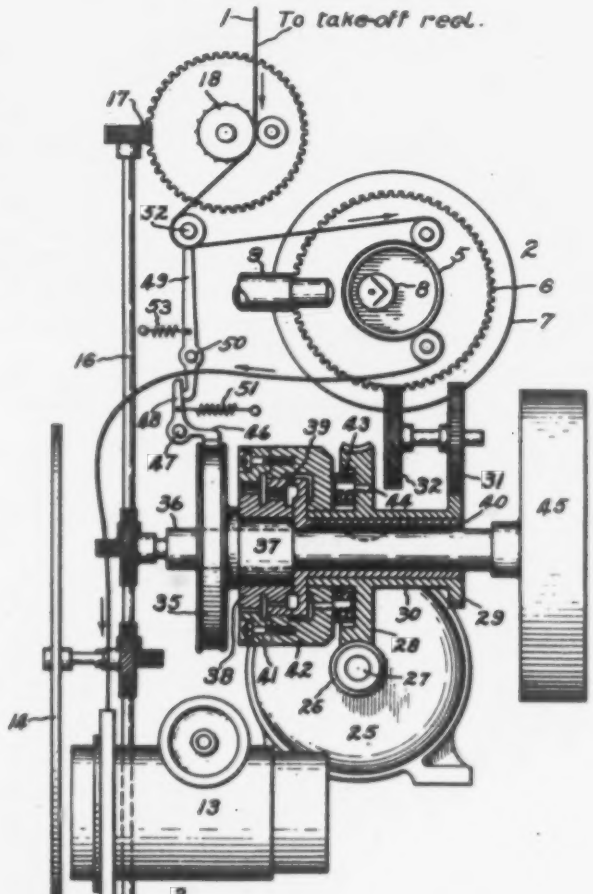
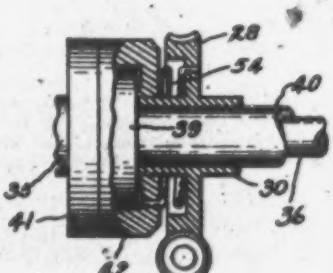


Fig. 2.



Inventor
Charles L. Heisler,
by Charles R. Mullen

Patented May 13, 1930

1,758,832

UNITED STATES PATENT OFFICE

CHARLES L. HEISLER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

FILM-DRIVING APPARATUS

Application filed March 27, 1929. Serial No. 350,405.

My invention relates to apparatus for recording sound on a film and to apparatus for reproducing sound from a film record. More particularly my invention relates to means for driving the film in apparatus of the abovementioned character, and it has for its object the provision of improved means for driving the film through the apparatus from a single driving source so that the speed of the film at the point at which the sound is being recorded in the case of a recorder or at the point at which the recorded sound is being taken from the film record in the case of a reproducer shall be uniform and unaffected by conditions affecting the speed of the film in other parts of the apparatus.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

I have chosen to illustrate my invention as applied to apparatus combining a film phonograph with a motion picture projector, both the sound and picture records being on the same film. In the drawing Fig. 1 represents a preferred embodiment of my invention, and Fig. 2 is a detail showing a modification.

Referring to Fig. 1, the film 1 of the motion picture type having in the present embodiment both picture and sound records thereon passes from the usual take-off reel, not shown, to the sound apparatus 2, thence to the picture apparatus 3, and then on to the usual take-up reel. The sound apparatus may be either a recorder or a reproducer and the picture apparatus may be either a camera or a projector. In the drawing I have chosen to show the sound apparatus as a part of a reproducer and the picture apparatus as a part of a projector.

The sound reproducer shown comprises the rotatable film supporting and driving drum 5 on the shaft of which is mounted the gear 6 and the flywheel 7. That portion of the film having the sound record thereon, a narrow transverse line of light on the moving sound record from which it passes on under the control of the record into the cell 8. In the well understood manner, impulses received from the latter after being amplified by suitable thermionic amplifying devices may be used to actuate a sound producing device such as a loud speaker. By this arrangement the film is supported at the point of light control by the drum. I may, however, support the film at the point of control by means of a skid or a gate to which the drum is closely adjacent, the drum in all cases giving to the film a movement which is uniform to that high degree necessary to the faithful reproduction of music.

The picture projecting apparatus illustrated is that common to apparatus of this character and comprises the gate 12, the objective 13, the shutter 14, and the intermittent film driving mechanism 15. The two latter members are shown connected by gears to the vertical shaft 16 at the upper end of which is a gear connection 17 to the sprocket 18 which serves to withdraw the film from the unwinding reel, not shown. By gear connection 19 with the intermittent mechanism the sprocket 20 is rotated and by means of a suitable connection, as for example the belt 21, the take-up reel 22 may be operated in the usual and well known manner.

The single driving motor 25 is connected to all of the film driving members of the apparatus. Its connection with the drum 5 is through the worm 26 on motor shaft 27, worm wheel 28 and gear 29 on sleeve 30 and gears 31, 32 and 6. Inasmuch as the film is driven jointly by the several sprockets and a drum and since it is highly desirable that there shall not be the slightest amount of slippage of the film on the drum, it becomes necessary to coordinate the motion of the drum and the sprockets so that both shall move the film at exactly the same speed regardless of any variation in the actual diameter of the drum from the theoretical diameter and re-

May 13, 1930. C. L. HEISLER 1,758,832

FILM DRIVING APPARATUS

Filed March 27, 1929

Fig. 1.

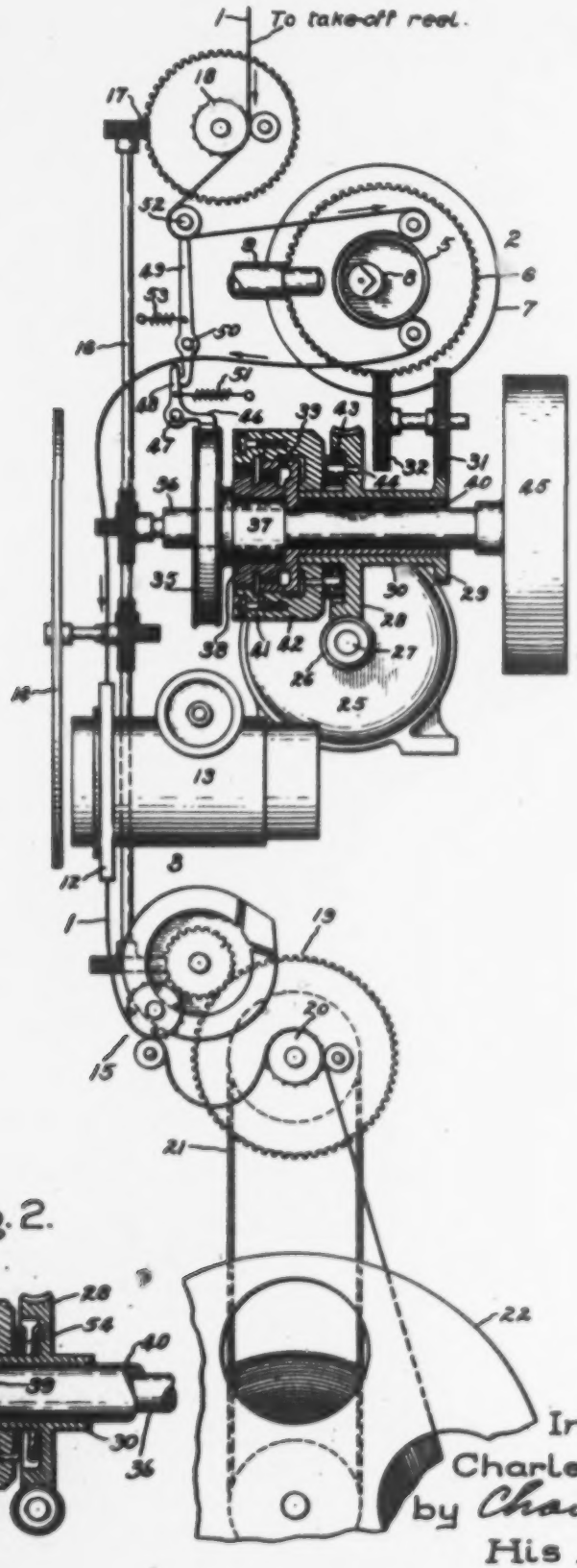
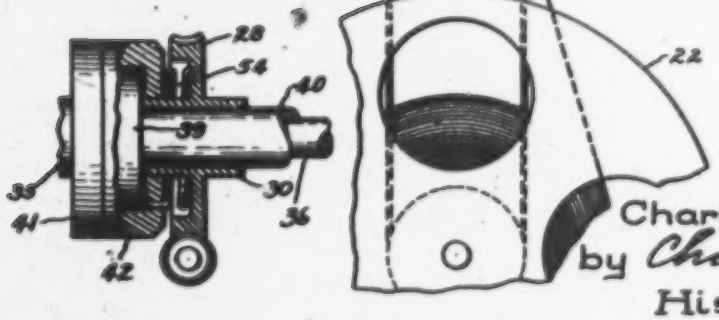


Fig. 2.



Inventor
Charles L. Heisler,
by Charles E. Mullen
His Attorney.

UNITED STATES PATENT OFFICE

CHARLES L. HEISLER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

FILM-DRIVING APPARATUS

Application filed March 27, 1929. Serial No. 350,405.

My invention relates to apparatus for recording sound on a film and to apparatus for reproducing sound from a film record. More particularly my invention relates to means for driving the film in apparatus of the abovementioned character, and it has for its object the provision of improved means for driving the film through the apparatus from a single driving source so that the speed of the film at the point at which the sound is being recorded in the case of a recorder or at the point at which the recorded sound is being taken from the film record in the case of a reproducer shall be uniform and unaffected by conditions affecting the speed of the film in other parts of the apparatus.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

I have chosen to illustrate my invention as applied to apparatus combining a film phonograph with a motion picture projector, both the sound and picture records being on the same film. In the drawing Fig. 1 represents a preferred embodiment of my invention, and Fig. 2 is a detail showing a modification.

Referring to Fig. 1, the film 1 of the motion picture type having in the present embodiment both picture and sound records thereon passes from the usual take-off reel, not shown, to the sound apparatus 2, thence to the picture apparatus 3, and then on to the usual take-up reel. The sound apparatus may be either a recorder or a reproducer and the picture apparatus may be either a camera or a projector. In the drawing I have chosen to show the sound apparatus as a part of a reproducer and the picture apparatus as a part of a projector.

The sound reproducer shown comprises the rotatable film supporting and driving drum 5 on the shaft of which is mounted the gear 6 and the flywheel 7. That portion of the film having the sound record thereon, although supported by the drum, overhangs the edge thereof and within the drum is a suitable photoelectric cell 8. A suitable optical system indicated in part at 9 projects a narrow transverse line of light on the moving sound record from which it passes on under the control of the record into the cell 8. In the well understood manner, impulses received from the latter after being amplified by suitable thermionic amplifying devices may be used to actuate a sound producing device such as a loud speaker. By this arrangement the film is supported at the point of light control by the drum. I may, however, support the film at the point of control by means of a skid or a gate to which the drum is closely adjacent, the drum in all cases giving to the film a movement which is uniform to that high degree necessary to the faithful reproduction of music.

The picture projecting apparatus illustrated is that common to apparatus of this character and comprises the gate 12, the objective 13, the shutter 14, and the intermittent film driving mechanism 15. The two latter members are shown connected by gears to the vertical shaft 16 at the upper end of which is a gear connection 17 to the sprocket 18 which serves to withdraw the film from the unwinding reel, not shown. By gear connection 19 with the intermittent mechanism the sprocket 20 is rotated and by means of a suitable connection, as for example the belt 21, the take-up reel 22 may be operated in the usual and well known manner.

The single driving motor 25 is connected to all of the film driving members of the apparatus. Its connection with the drum 5 is through the worm 26 on motor shaft 27, worm wheel 28 and gear 29 on sleeve 30 and gears 31, 32 and 6. Inasmuch as the film is driven jointly by the several sprockets and a drum and since it is highly desirable that there shall not be the slightest amount of slippage of the film on the drum, it becomes necessary to coordinate the motion of the drum and the sprockets so that both shall move the film at exactly the same speed regardless of any variation in the actual diameter of the drum from the theoretical diameter and regardless of variations in the length of the film due for example to shrinkage. In the present arrangement I prefer to positively connect the driving motor with the drum

and by means of a variable connection between the motor and the sprockets to cause the speed of the latter to be varied automatically so that both drum and sprockets shall move the film at the same speed. This mechanism I have disclosed and claimed in my copending applications, Serial No. 203,344, filed July 5, 1927, and Serial No. 341,147 filed February 19, 1929, both assigned to the same assignee as the present application. The above mentioned mechanism I have termed a compensator and as shown on the drawing comprises the brake drum 35 loosely mounted on the shaft 36 and having an eccentric hub portion 37 upon which is journalled the double gear member 38. This gear member has two rows of teeth, the pitch diameter of one row being slightly smaller than that of the other, for example, the smaller gear may have one tooth less than the larger gear. Meshing with the smaller of the two gears is the internal gear 39 formed on the end of the sleeve 40 which is keyed to the shaft 36. Meshing with the larger of the two gears is the internal gear 41 secured to the ring 42 which is journalled in the sleeve 30 and on the outer face of the internal gear 39. Ring 42 has a drive connection with the worm gear 28 through a member composed of any suitable elastic material which member, for example, is shown in the drawing as the leather cushion ring 43. The ring has a series of holes therein into which project the pins 44, alternate pins being secured respectively to the ring 42 and the worm gear 28. At the end of the shaft 36 is a gear connection with the vertical shaft 16 and at the other end I have shown the flywheel 45. Under certain conditions sufficient inertia effect to insure steady running of the sprockets may be had from the mass of the compensator itself, or if this is not sufficient I may increase the mass thereof, for example, by enlarging the ring 42. Arranged to engage the brake drum 35 is the brake lever 46 pivoted at 47 and having the arm 48 which is engaged by the short arm of the lever 49 pivoted at 50. Spring 51 is connected to the brake lever to rotate it in a direction to apply the brake. The long arm of lever 49 carries the idler 52 engaging a loop in the film between sprocket 18 and drum 5, and has attached to it spring 53.

The operation of the compensator will readily be understood from the description and drawing. If the film is being moved somewhat faster by the sprockets than by the drum, the film loop engaged by the idler 52 will slowly increase in size and lever 49 moving counterclockwise will allow spring 51 to apply the brake to slow down the drum 35 in the description that the parts of the mechanism are so constructed that when the brake is out of contact with the brake drum and the elements of the compensator are rotating freely, the sprockets move the film even though it be new or unshrunken at an appreciably greater speed than the drum moves it. Also if the brake is applied with the full force of the spring 51 so that the brake wheel is held fixed, the sprockets move the film even though it be badly shrunken at an appreciably slower speed than the drum moves it. Conversely if conditions are such that the film is being moved somewhat slower by the sprockets than by the drum the loop decreases in size and the brake is slowly withdrawn until the sprocket speed increases to the proper amount.

In motion picture apparatus of the character which I have described wherein, for example, the film is withdrawn from a take-off reel, drawn through a gate by an intermittent motion mechanism, and wound up on a take-up reel, it is not unusual that the speed of the apparatus is found to undergo considerable variation even though the driving motor operates with a uniform torque. These speed variations are due to a variety of causes consisting in a large part to the varying resistance of the film and other moving parts. One or both of the reels may bind at certain angular positions thereof producing a periodic drag. Improper gear and sprocket action, displacement of the film on the sprockets and in the gate and warping of the film may produce a drag at frequent or recurring intervals. In the case of machines for showing pictures only, speed variations such as may be due to such causes are not noticeable to one observing the pictures but in the case of a machine which also reproduces sound recorded on the film it is essential that the film for proper sound reproduction be moved through the light beam, termed the point of control, at a uniform and unvarying speed since small variations in pitch are readily detected by the ear. Steadiness of rotation of the film drum 5 in the apparatus which I have described is effected in part by the use of the flywheel 7 directly connected therewith. It is further effected by eliminating from the film drum substantially all effects of the speed variations of the sprockets and reels. The rotating mass of the compensator and flywhel 45 or of the compensator alone where the flywheel is not used irons out more or less of the speed variations of the sprockets. Variations not thus absorbed are taken up by the cushion ring 43 inserted in the

drum to be driven through the elastic connection rather than the sprockets the effect of hunting on the reproduction of the sound could not be tolerated. As regards movement of the film in the picture projecting apparatus, however, speed variations due to hunting are not noticed by a person observing the pictures. It will therefore be seen that by means of the apparatus which I have disclosed herein the drum which supports and drives the film at the point of sound control has a non-elastic connection with the driving motor and in addition to the inherent inertia effect of the motor rotor operating at a high speed also has a flywheel directly associated with its shaft. The drive of the film in all other parts of the machine is through an elastic member which while preserving proper synchronism between the pictures and sound absorbs such speed variations as occur in the other parts of the machine and prevent their reaction on the sound reproducing apparatus.

In the modification illustrated by Fig. 2 I have shown instead of the cushion ring 43 in the drive connection to the sprockets the coil spring 54 having its ends secured respectively to the ring 42 and the worm wheel 28.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. In film phonograph apparatus of the character described, driving means for the film comprising a rotatable member arranged to engage the film adjacent the point of control, film driving apparatus spaced from said rotatable member and also arranged to engage the film, a motor having driving connections with said rotatable member and said driving apparatus, inertia means associated with said driving apparatus, and an elastic member between the inertia means and the motor.

2. In film phonograph apparatus of the character described, film driving means comprising a rotatable member arranged to engage the film adjacent the point of control, a film driving member subject to variations in film resistance, inertia means associated with said film driving member, a motor driven shaft, a substantially inelastic connection between said shaft and the rotatable member, and an elastic connection between said shaft and the film driving member.

3. In film phonograph apparatus of the character described, a film driving means comprising a drum arranged to move the film at a uniform speed at the point of control, a film driving sprocket subject to variations in film resistance, inertia means

4. In film phonograph apparatus of the character described, a film driving drum having a flywheel associated therewith, a sprocket arranged to withdraw the film from a take-off reel, means arranged to rotate a take-up reel for the film, a common driving motor having an inelastic connection with said drum, a flywheel associated with said sprocket and said means and an elastic member connecting the motor with said sprocket and said means.

In witness whereof, I have hereunto set my hand this 26th day of March, 1929.

CHARLES L. HEISLER.

and by means of a variable connection between the motor and the sprockets to cause the speed of the latter to be varied automatically so that both drum and sprockets shall move the film at the same speed. This mechanism I have disclosed and claimed in my copending applications, Serial No. 203,344, filed July 5, 1927, and Serial No. 341,147 filed February 19, 1929, both assigned to the same assignee as the present application. The above mentioned mechanism I have termed a compensator and as shown on the drawing comprises the brake drum 35 loosely mounted on the shaft 36 and having an eccentric hub portion 37 upon which is journalled the double gear member 38. This gear member has two rows of teeth, the pitch diameter of one row being slightly smaller than that of the other, for example, the smaller gear may have one tooth less than the larger gear. Meshing with the smaller of the two gears is the internal gear 39 formed on the end of the sleeve 40 which is keyed to the shaft 36. Meshing with the larger of the two gears is the internal gear 41 secured to the ring 42 which is journalled in the sleeve 30 and on the outer face of the internal gear 39. Ring 42 has a drive connection with the worm gear 28 through a member composed of any suitable elastic material which member, for example, is shown in the drawing as the leather cushion ring 43. The ring has a series of holes therein into which project the pins 44, alternate pins being secured respectively to the ring 42 and the worm gear 28. At the end of the shaft 36 is a gear connection with the vertical shaft 16 and at the other end I have shown the flywheel 45. Under certain conditions sufficient inertia effect to insure steady running of the sprockets may be had from the mass of the compensator itself, or if this is not sufficient I may increase the mass thereof, for example, by enlarging the ring 42. Arranged to engage the brake drum 35 is the brake lever 46 pivoted at 47 and having the arm 48 which is engaged by the short arm of the lever 49 pivoted at 50. Spring 51 is connected to the brake lever to rotate it in a direction to apply the brake. The long arm of lever 49 carries the idler 52 engaging a loop in the film between sprocket 18 and drum 5, and has attached to it spring 53.

The operation of the compensator will readily be understood from the description and drawing. If the film is being moved somewhat faster by the sprockets than by the drum, the film loop engaged by the idler 52 will slowly increase in size and lever 49 moving counterclockwise will allow spring 51 to apply the brake 46 to drum 35 with greater force. The resulting decrease in rotative speed of the brake drum and the eccentric hub 37 carrying the double gear 38 slows down the speed of shaft 36 which drives the

In the description that the parts of the mechanism are so constructed that when the brake is out of contact with the brake drum and the elements of the compensator are rotating freely, the sprockets move the film even though it be new or unshrunken at an appreciably greater speed than the drum moves it. Also if the brake is applied with the full force of the spring 51 so that the brake wheel is held fixed, the sprockets move the film even though it be badly shrunken at an appreciably slower speed than the drum moves it. Conversely if conditions are such that the film is being moved somewhat slower by the sprockets than by the drum the loop decreases in size and the brake is slowly withdrawn until the sprocket speed increases to the proper amount.

In motion picture apparatus of the character which I have described wherein, for example, the film is withdrawn from a take-off reel, drawn through a gate by an intermittent motion mechanism, and wound up on a take-up reel, it is not unusual that the speed of the apparatus is found to undergo considerable variation even though the driving motor operates with a uniform torque. These speed variations are due to a variety of causes consisting in a large part to the varying resistance of the film and other moving parts. One or both of the reels may bind at certain angular positions thereof producing a periodic drag. Improper gear and sprocket action, displacement of the film on the sprockets and in the gate and warping of the film may produce a drag at frequent or recurring intervals. In the case of machines for showing pictures only, speed variations such as may be due to such causes are not noticeable to one observing the pictures but in the case of a machine which also reproduces sound recorded on the film it is essential that the film for proper sound reproduction be moved through the light beam, termed the point of control, at a uniform and unvarying speed since small variations in pitch are readily detected by the ear. Steadiness of rotation of the film drum 5 in the apparatus which I have described is effected in part by the use of the flywheel 7 directly connected therewith. It is further effected by eliminating from the film drum substantially all effects of the speed variations of the sprockets and reels. The rotating mass of the compensator and flywhel 45 or of the compensator alone where the flywheel is not used irons out more or less of the speed variations of the sprockets. Variations not thus absorbed are taken up by the cushion ring 43 inserted in the sprocket drive connection between the worm wheel and the compensator or flywheel. Where a rotating mass subject to speed variations is driven through an elastic connection there is often a tendency to hunt. In the

tion rather than the sprockets the effect of hunting on the reproduction of the sound could not be tolerated. As regards movement of the film in the picture projecting apparatus, however, speed variations due to hunting are not noticed by a person observing the pictures. It will therefore be seen that by means of the apparatus which I have disclosed herein the drum which supports and drives the film at the point of sound control has a non-elastic connection with the driving motor and in addition to the inherent inertia effect of the motor rotor operating at a high speed also has a flywheel directly associated with its shaft. The drive of the film in all other parts of the machine is through an elastic member which while preserving proper synchronism between the pictures and sound absorbs such speed variations as occur in the other parts of the machine and prevent their reaction on the sound reproducing apparatus.

In the modification illustrated by Fig. 2 I have shown instead of the cushion ring 43 in the drive connection to the sprockets the coil spring 54 having its ends secured respectively to the ring 42 and the worm wheel 28.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. In film phonograph apparatus of the character described, driving means for the film comprising a rotatable member arranged to engage the film adjacent the point of control, film driving apparatus spaced from said rotatable member and also arranged to engage the film, a motor having driving connections with said rotatable member and said driving apparatus, inertia means associated with said driving apparatus, and an elastic member between the inertia means and the motor.

2. In film phonograph apparatus of the character described, film driving means comprising a rotatable member arranged to engage the film adjacent the point of control, a film driving member subject to variations in film resistance, inertia means associated with said film driving member, a motor driven shaft, a substantially inelastic connection between said shaft and the rotatable member, and an elastic connection between said shaft and the film driving member.

3. In film phonograph apparatus of the character described, a film driving means comprising a drum arranged to move the film at a uniform speed at the point of control, a film driving sprocket subject to variations in film resistance, inertia means associated with said sprocket, a motor driven shaft, a substantially inelastic connection between said shaft and said drum, and an elastic connection between said shaft and said sprocket.

character described, a film driving drum having a flywheel associated therewith, a sprocket arranged to withdraw the film from a take-off reel, means arranged to rotate a take-up reel for the film, a common driving motor having an inelastic connection with said drum, a flywheel associated with said sprocket and said means and an elastic member connecting the motor with said sprocket and said means.

In witness whereof, I have hereunto set my hand this 26th day of March, 1929.

CHARLES L. HEISLER.

PLAINTIFFS' EXHIBIT NO. 50.

United States Patent No. 1,768,403.

478

June 24, 1930. C. L. HEISLER 1,768,403

FILM DRIVING MEANS

Filed Sept. 18, 1928

Fig. 1.

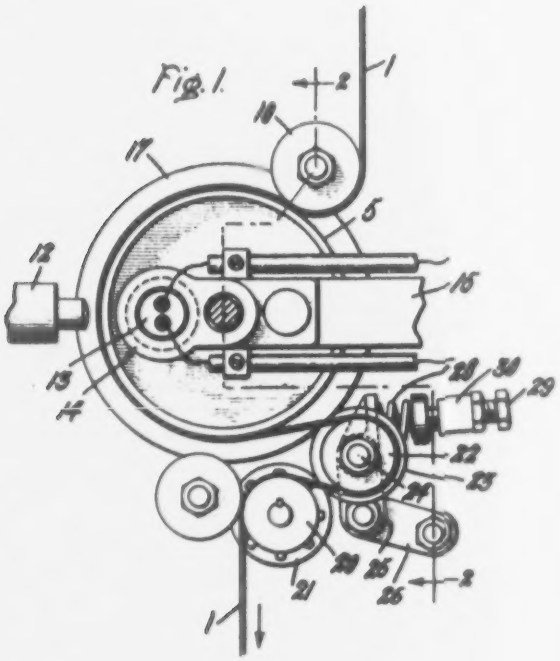
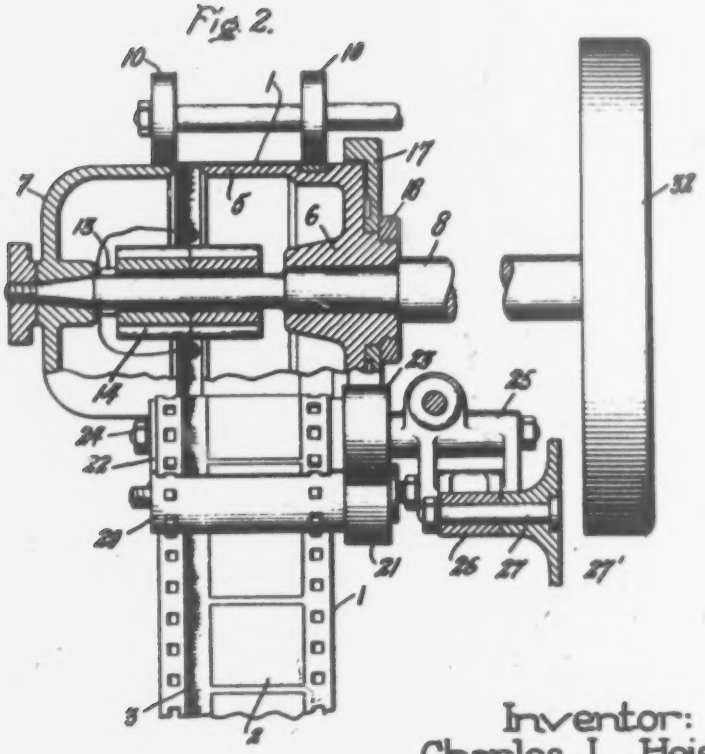


Fig. 2.



Inventor:
Charles L. Heisler,
by Charles L. Heisler

Patented June 24, 1930 1,768,403

UNITED STATES PATENT OFFICE

CHARLES L. HEISLER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

FILM-DRIVING MEANS

Application filed September 18, 1928. Serial No. 306,684.

My invention relates to the recording of sound on a film and to the reproduction of sound from a film record. More particularly it relates to mechanism for driving the film at the point at which the record is made thereon or at the point at which the record is translated therefrom as the case may be. One object of my invention is to provide an improved film driving mechanism which shall relieve the film of excessive tension. Another object is to provide a film driving mechanism including a sprocket with which mechanism the movement of the film shall be less subject to the effect of defective sprocket holes and weak portions therein. A further object of my invention is to provide a film driving mechanism including a sprocket wherein a stretched or shrunken film shall nevertheless have a smooth sprocket action.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1, is a fragmentary view of apparatus involving my invention for reproducing sound from a photographic film record and Fig. 2 is a cross section of the same taken on line 2—2 of Fig. 1.

I have chosen to illustrate my invention as applied to apparatus for reproducing sound from a photographic film record although it will be understood that it is also applicable to apparatus for recording sound on a film. The film 1 which I have chosen to show in connection with my apparatus has a series of motion pictures 2 thereon and a sound record 3 of the variable width type extending along one side of the picture record which after suitable amplification may be fed to a loud speaker or other translating device. At the point at which the light beam engages the film it is essential for faithful recording or reproduction as the case may be that the film be firmly supported and be moved with a perfectly uniform rate. In the drawing I have shown the film 1 supported by the drum 5 which is formed in two parts 6 and 7, the former being fixed to the freely rotatable shaft 8 while the latter is detachably mounted on the reduced end portion of the same shaft. The two drum parts 6 and 7 are spaced apart a distance slightly more than the maximum width of the sound record and the film is guided on the drum in such a manner that the sound record lies opposite the space between the drum parts. A pair of suitable rollers 10 press the film against the drum face. By means of a suitable optical system, a portion of which is shown at 12, a light beam of the desired dimensions is directed on that portion of the film bearing the sound record, the point of interception of the beam and film being termed the point of record translation, and within the drum in a position to receive the light beam after passing through the sound record is the photo-electric cell 13. The cell is secured in the bracket 14 which surrounds the reduced end of shaft 8 and which is supported in a fixed position by the arm 15 extending out through the space between the two drum parts. Part 6 of the drum is provided with the friction roll 17 which is frictionally held in engagement therewith by the nut 18, the adjustment thereof being such that slipping normally does not occur between the drum and the roll 17. The provision of the yielding frictional engagement

FILM DRIVING MEANS

Filed Sept. 18, 1928

Fig. 1.

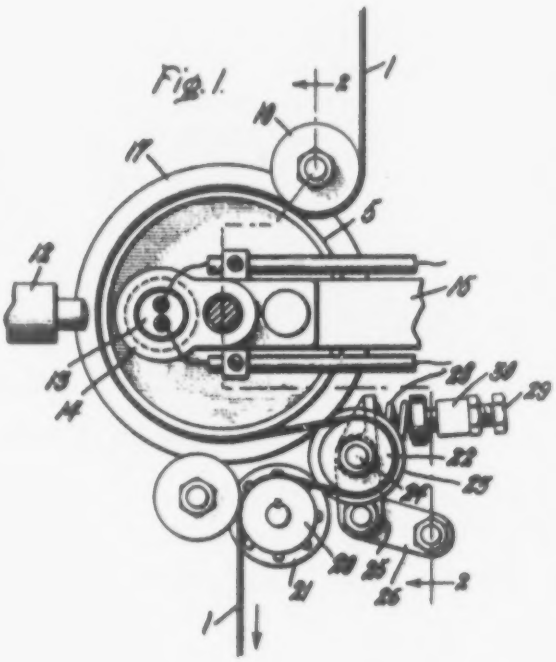
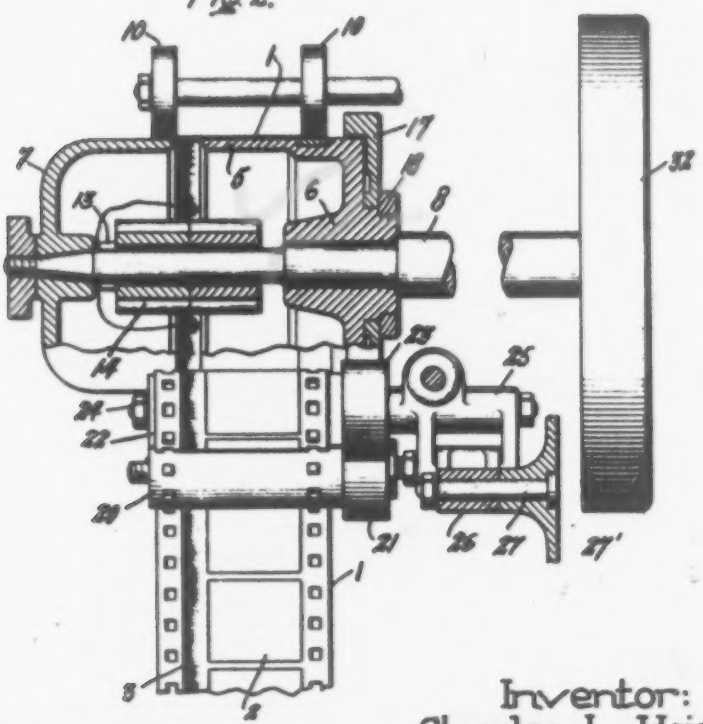


Fig. 2.



Inventor:
Charles L. Heisler,
by Charles F. Mullen
His Attorney

UNITED STATES PATENT OFFICE

CHARLES L. HEISLER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

FILM-DRIVING MEANS

Application filed September 18, 1928. Serial No. 306,684.

My invention relates to the recording of sound on a film and to the reproduction of sound from a film record. More particularly it relates to mechanism for driving the film at the point at which the record is made thereon or at the point at which the record is translated therefrom as the case may be. One object of my invention is to provide an improved film driving mechanism which shall relieve the film of excessive tension. Another object is to provide a film driving mechanism including a sprocket with which mechanism the movement of the film shall be less subject to the effect of defective sprocket holes and weak portions therein. A further object of my invention is to provide a film driving mechanism including a sprocket wherein a stretched or shrunken film shall nevertheless have a smooth sprocket action.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1, is a fragmentary view of apparatus involving my invention for reproducing sound from a photographic film record and Fig. 2 is a cross section of the same taken on line 2—2 of Fig. 1.

I have chosen to illustrate my invention as applied to apparatus for reproducing sound from a photographic film record although it will be understood that it is also applicable to apparatus for recording sound on a film. The film 1 which I have chosen to show in connection with my apparatus has a series of motion pictures 2 thereon and a sound record 3 of the variable width type extending along one side of the picture record. A narrow light beam of the order of one mil or less is passed through the sound record portion of the moving film into a photo-electric cell, the resulting varying current from which after suitable amplification may be fed to a loud speaker or other translating device. At the point at which the light beam engages the film it is essential for faithful recording or reproduction as the case may be that the film be firmly supported and be moved with a perfectly uniform rate. In the drawing I have shown the film 1 supported by the drum 5 which is formed in two parts 6 and 7, the former being fixed to the freely rotatable shaft 8 while the latter is detachably mounted on the reduced end portion of the same shaft. The two drum parts 6 and 7 are spaced apart a distance slightly more than the maximum width of the sound record and the film is guided on the drum in such a manner that the sound record lies opposite the space between the drum parts. A pair of suitable rollers 10 press the film against the drum face. By means of a suitable optical system, a portion of which is shown at 12, a light beam of the desired dimensions is directed on that portion of the film bearing the sound record, the point of interception of the beam and film being termed the point of record translation, and within the drum in a position to receive the light beam after passing through the sound record is the photo-electric cell 13. The cell is secured in the bracket 14 which surrounds the reduced end of shaft 8 and which is supported in a fixed position by the arm 15 extending out through the space between the two drum parts. Part 6 of the drum is provided with the friction roll 17 which is frictionally held in engagement therewith by the nut 18, the adjustment thereof being such that slipping normally does not occur between the drum and the roll 17. The provision of the yielding frictional engagement between the members 6 and 17 is in the nature of a safeguard to save the film from an excessive strain.

Sprocket 20 which is driven at uniform speed by suitable means not shown, such

for example as a synchronous electric motor, has the friction roll 21 at one end thereof. Between the sprocket 20 and the drum 5 the film passes in a loop over the film roll 22 at one end of which is the friction roll 23 which is held in yielding engagement with the friction rolls 17 and 21. Film roll 22 and its associated friction roll are rotatably mounted on the shaft 24 which shaft is carried by a jointed bracket comprising the members 25 and 26, the latter being pivoted on the fixed pin 27 shown supported by a boss on the interior of the enclosing casing 27'. The degree of pressure desired between friction roll 23 and friction rolls 17 and 21 is obtained by the spring 28 whose tension may be varied by means of the adjusting screw 29 threaded in the fixed post 30.

I have found in machines heretofore constructed wherein the drum was driven solely by the tension of the film passing over it that at times, for example when starting, the film between the sprocket and the drum would be subjected to a dangerously high tension. Vibrations also would be transmitted to the drum if the film contained defective sprocket holes or weak spots or if the sprocket action of the film were imperfect such as might result from either a stretching or a shrinkage of the film. By means of the apparatus which I have illustrated I avoid these disadvantages. I drive the drum jointly by the film and by a positive connection with the sprocket. I construct the drum, the film roll and the sprocket each having a diameter so related to the diameter of its respective friction roll that when using a film of standard thickness there shall be no slippage between the film and the drum but there shall be a slight forward creepage of the film roll relative to the film thereon. Thus the roll 22 acts in the nature of a capstan, that portion of the film between the roll and the sprocket being under less tension than that portion between the roll and the drum. It will be noted that the film makes a reverse bend in passing from the sprocket to the roll and the natural resilience of the film in this portion where the tension is light serves to absorb a large part of the sprocket tooth vibrations before they can reach the drum. A further advantage of feeding the film to the sprocket at a light tension is that if the film is appreciably stretched it will not be forced to the bottom of each tooth immediately as the successive teeth engage it, hence better sprocket action results and less sprocket tooth vibration is set up. If desired, greater uniformity in speed of the film may be obtained by the use of a flywheel on the drum shaft or on the sprocket tion rolls may be provided with tires of rubber or the like to increase the traction.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. Film driving means including a drum, a film roll and a driven member over which members a film is adapted to pass serially, said members having friction rolls associated therewith and arranged in engagement with one another to supply a driving torque to the drum from the driven member through the film roll.

2. Film driving means including a drum, a driven sprocket, and a yieldably mounted film roll over which members a film is adapted to pass serially, said members having friction rolls connected therewith and engaging one another to supply a positive driving torque to the drum from the sprocket through the film roll.

3. Film driving mechanism including a drum, a sprocket, a driving connection therebetween, and a roll arranged to engage a loop in a film passing from the drum to the sprocket, said roll being driven from the sprocket at a speed slightly greater than the speed of the film thereon.

4. In film driving mechanism having a sprocket adapted to engage and move a film past a point of record translation, means for reducing vibration in the film at said point arising from sprocket tooth action therewith including a roll arranged to engage said film between the sprocket and said point and means for driving the roll at a speed to cause a slight forward creepage of the roll relative to the film.

5. Film driving mechanism including a film roll and a driving sprocket over which a film is adapted to pass successively, and a driving connection between the sprocket and the roll for rotating the roll at a speed slightly greater than the speed at which the film is moved by the sprocket.

6. Film driving mechanism including a driving sprocket adapted to be engaged by and to move a film, a roll arranged to engage the film as it approaches the sprocket and means for rotating the roll from the sprocket to decrease the tension of the film approaching the sprocket.

7. Film supporting and driving mechanism including a drum, a film roll and a driving sprocket over which a film is adapted to pass serially, friction rolls associated with each of said members arranged to form a driving train from the sprocket to the drum, the film roll being constructed to have a peripheral speed slightly greater than the speed of the film thereon.

8. Film supporting and driving mechanism including a drum, a film roll, and a

the drum, a friction roll fixed to the sprocket, a friction roll fixed to the film roll and arranged yieldingly to engage the friction rolls of the drum and the sprocket, the diameters of the friction rolls being such that no slipping occurs between the film and the drum but there occurs a slight forward creeping of the idler relative to the film thereon.

In witness whereof, I have hereunto set my hand this 17th day of September, 1928.

CHARLES L. HEISLER.

tor, has the friction roll 21 at one end thereof. Between the sprocket 20 and the drum 5 the film passes in a loop over the film roll 22 at one end of which is the friction roll 23 which is held in yielding engagement with the friction rolls 17 and 21. Film roll 22 and its associated friction roll are rotatably mounted on the shaft 24 which shaft is carried by a jointed bracket comprising the members 25 and 26, the latter being pivoted on the fixed pin 27 shown supported by a boss on the interior of the enclosing casing 27'. The degree of pressure desired between friction roll 23 and friction rolls 17 and 21 is obtained by the spring 28 whose tension may be varied by means of the adjusting screw 29 threaded in the fixed post 30.

I have found in machines heretofore constructed wherein the drum was driven solely by the tension of the film passing over it that at times, for example when starting, the film between the sprocket and the drum would be subjected to a dangerously high tension. Vibrations also would be transmitted to the drum if the film contained defective sprocket holes or weak spots or if the sprocket action of the film were imperfect such as might result from either a stretching or a shrinkage of the film. By means of the apparatus which I have illustrated I avoid these disadvantages. I drive the drum jointly by the film and by a positive connection with the sprocket. I construct the drum, the film roll and the sprocket each having a diameter so related to the diameter of its respective friction roll that when using a film of standard thickness there shall be no slippage between the film and the drum but there shall be a slight forward creepage of the film roll relative to the film thereon. Thus the roll 22 acts in the nature of a capstan, that portion of the film between the roll and the sprocket being under less tension than that portion between the roll and the drum. It will be noted that the film makes a reverse bend in passing from the sprocket to the roll and the natural resilience of the film in this portion where the tension is light serves to absorb a large part of the sprocket tooth vibrations before they can reach the drum. A further advantage of feeding the film to the sprocket at a light tension is that if the film is appreciably stretched it will not be forced to the bottom of each tooth immediately as the successive teeth engage it, hence better sprocket action results and less sprocket tooth vibration is set up. If desired, greater uniformity in speed of the film may be obtained by the use of a flywheel on the drum shaft or on the sprocket shaft or on both. In the drawing I have shown the drum shaft provided with the flywheel 32. If desired also the several friber or the like to increase the traction.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. Film driving means including a drum, a film roll and a driven member over which members a film is adapted to pass serially, said members having friction rolls associated therewith and arranged in engagement with one another to supply a driving torque to the drum from the driven member through the film roll.

2. Film driving means including a drum, a driven sprocket, and a yieldably mounted film roll over which members a film is adapted to pass serially, said members having friction rolls connected therewith and engaging one another to supply a positive driving torque to the drum from the sprocket through the film roll.

3. Film driving mechanism including a drum, a sprocket, a driving connection therebetween, and a roll arranged to engage a loop in a film passing from the drum to the sprocket, said roll being driven from the sprocket at a speed slightly greater than the speed of the film thereon.

4. In film driving mechanism having a sprocket adapted to engage and move a film past a point of record translation, means for reducing vibration in the film at said point arising from sprocket tooth action therewith including a roll arranged to engage said film between the sprocket and said point and means for driving the roll at a speed to cause a slight forward creepage of the roll relative to the film.

5. Film driving mechanism including a film roll and a driving sprocket over which a film is adapted to pass successively, and a driving connection between the sprocket and the roll for rotating the roll at a speed slightly greater than the speed at which the film is moved by the sprocket.

6. Film driving mechanism including a driving sprocket adapted to be engaged by and to move a film, a roll arranged to engage the film as it approaches the sprocket and means for rotating the roll from the sprocket to decrease the tension of the film approaching the sprocket.

7. Film supporting and driving mechanism including a drum, a film roll and a driving sprocket over which a film is adapted to pass serially, friction rolls associated with each of said members arranged to form a driving train from the sprocket to the drum, the film roll being constructed to have a peripheral speed slightly greater than the speed of the film thereon.

8. Film supporting and driving mechanism including a drum, a film roll, and a driving sprocket over which a film is adapted to pass serially, a flywheel fixed to the drum, a friction roll frictionally secured to

the drum, a friction roll fixed to the sprocket, a friction roll fixed to the film roll and arranged yieldingly to engage the friction rolls of the drum and the sprocket, the diameters of the friction rolls being such that no slipping occurs between the film and the drum but there occurs a slight forward creeping of the idler relative to the film thereon.

In witness whereof, I have hereunto set my hand this 17th day of September, 1928.

CHARLES L. HEISLER.

PLAINTIFFS' EXHIBIT NO. 51.

United States Patent No. 1,780,681.

484

Nov. 4, 1930. E. W. KELLOGG 1,780,681

SOUND RECORDING AND REPRODUCING APPARATUS

Original Filed July 27, 1928

Fig. 1.

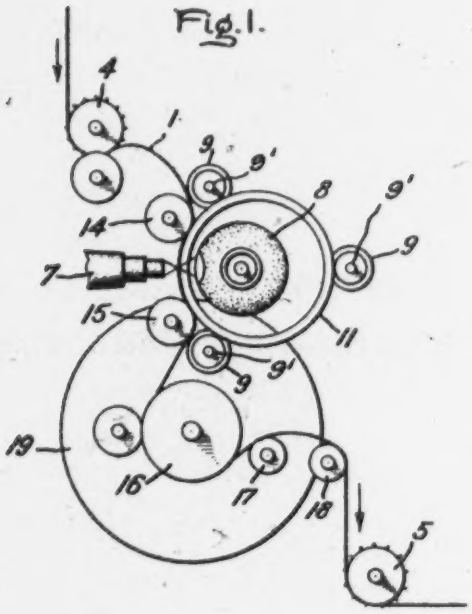
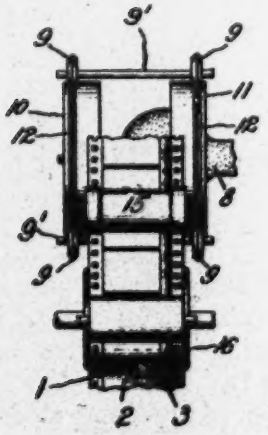


Fig. 2.



Inventor:
Edward W. Kellogg
by Charles V. Mullen
His Attorney.

Patented Nov. 4, 1930

485
1,780,681

UNITED STATES PATENT OFFICE

EDWARD W. KELLOGG, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

SOUND RECORDING AND REPRODUCING APPARATUS

Original application filed July 27, 1928, Serial No. 295,780. Divided and this application filed October 4, 1929. Serial No. 397,395.

My invention relates to apparatus for recording sound on a moving film and to apparatus for reproducing sound from a film record. It is the object of my invention to provide in apparatus of this character improved means for supporting the moving film at the point at which the record is made on the film or is taken from the film record.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

This application is a division of my copending application, Serial No. 295,780, filed July 27, 1928.

Referring to the drawing, Fig. 1 is a front view of apparatus involving my invention, and Fig. 2 is a side view of the same.

The film 1, which is shown as having the picture record 2 and the sound record 3 at one side thereof, is driven at the proper speed by the sprockets 4 and 5, which are geared to the same source of power, not shown, which for example may be a constant speed electric motor. At 7 I have shown a portion of an optical system by means of which a light beam is focused to narrow transverse light line on the sound record 3. If the apparatus is used to record sound the light beam is varied in accordance with the sound waves to variably expose the film. The light variations may comprise changes in intensity without change in the length of the light line on the film, thus producing the variable density type of record or may comprise changes in the length of the line with a constant intensity of light. If the apparatus is used to reproduce sound from a sound record a constant source of light is used and a photo-electric cell is arranged to receive the light passing through the film and modified by the sound record. In the drawing I have chosen to show the apparatus adapted for sound reproduction, hence the optical system 7 produces a constant intensity light beam which after passing through the focal point on the record ing film at the point of reproduction, that is, at the focal point of the light beam, I have provided the two similar freely rotatable rings 10 and 11. These rings are spaced apart so as to engage the film at the marginal or sprocket tooth opening portions and beyond the picture and sound records. Each ring is supported for free rotation by a plurality of rollers 9, three in the present example, mounted on spindles 9′ equally spaced about the periphery of the ring. Corresponding rollers of the two rings are shown mounted on a common spindle 9′ which is journaled in a suitable support, not shown. If desired, the rollers of the two rings may be individually mounted. The rings 10 and 11 are not only supported for free rotation on the rollers 9 but also are positioned laterally thereby and for this purpose each is provided with the groove 12, which is shown for example as V-shaped and engaged by the rollers 9 having a correspondingly shaped periphery. It is obvious that instead of rollers 9, the rings might be supported by means of balls running in ball races. The film is shown pressed against the faces of the rings by the pressure rolls 14 and 15. From the pressure roll 15 the film passes to the drum 16, thence over the idlers 17 and 18 to the drive sprocket 5. Secured to the shaft of drum 16 is a suitable fly wheel 19 whose inertia prevents the transmission to the reproducing point of small speed variations of sprocket 5, such for example as those due to improper sprocket action. In my copending application to which reference has been made above, I have described and claimed means by which a certain amount of driving torque is applied to the drum and flywheel from the driving motor. A further filtering of sprocket tooth vibrations is effected by the natural resilience of the film between idlers 17 and 18.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. In apparatus for recording sound on or reproducing sound from a moving film, a freely rotatable rotational

Nov. 4, 1930. E. W. KELLOGG 1,780,681

SOUND RECORDING AND REPRODUCING APPARATUS

Original Filed July 27, 1928

Fig. 1.

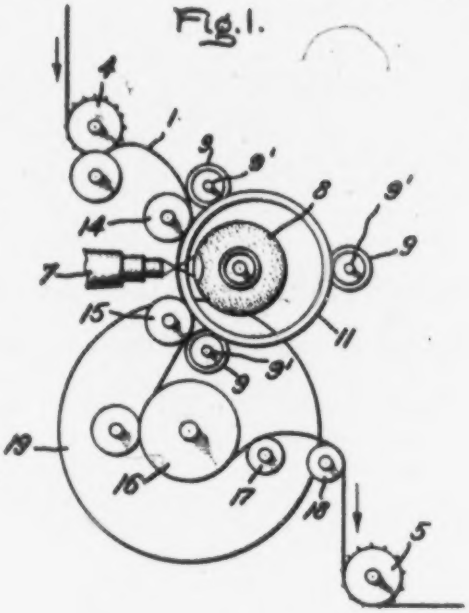
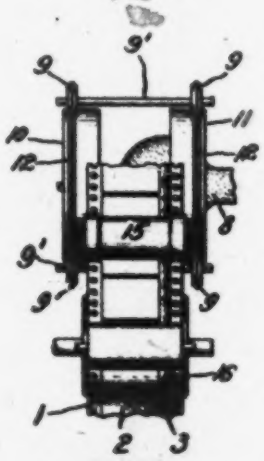


Fig. 2.



Inventor:
Edward W. Kellogg
by Charles V. Mullen
His Attorney.

UNITED STATES PATENT OFFICE

EDWARD W. KELLOGG, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

SOUND RECORDING AND REPRODUCING APPARATUS

Original application filed July 27, 1928, Serial No. 295,780. Divided and this application filed October 4, 1929. Serial No. 397,395.

My invention relates to apparatus for recording sound on a moving film and to apparatus for reproducing sound from a film record. It is the object of my invention to provide in apparatus of this character improved means for supporting the moving film at the point at which the record is made on the film or is taken from the film record.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

This application is a division of my copending application, Serial No. 295,780, filed July 27, 1928.

Referring to the drawing, Fig. 1 is a front view of apparatus involving my invention, and Fig. 2 is a side view of the same.

The film 1, which is shown as having the picture record 2 and the sound record 3 at one side thereof, is driven at the proper speed by the sprockets 4 and 5, which are geared to the same source of power, not shown, which for example may be a constant speed electric motor. At 7 I have shown a portion of an optical system by means of which a light beam is focused to narrow transverse light line on the sound record 3. If the apparatus is used to record sound the light beam is varied in accordance with the sound waves to variably expose the film. The light variations may comprise changes in intensity without change in the length of the light line on the film, thus producing the variable density type of record or may comprise changes in the length of the line with a constant intensity of light. If the apparatus is used to reproduce sound from a sound record a constant source of light is used and a photo-electric cell is arranged to receive the light passing through the film and modified by the sound record. In the drawing I have chosen to show the apparatus adapted for sound reproduction, hence the optical system 7 produces a constant intensity light beam which after passing through the focal point on the record passes on into the photo-electric cell 8 where it is transformed into corresponding current variation. For firmly supporting the moving film at the point of reproduction, that is, at the focal point of the light beam, I have provided the two similar freely rotatable rings 10 and 11. These rings are spaced apart so as to engage the film at the marginal or sprocket tooth opening portions and beyond the picture and sound records. Each ring is supported for free rotation by a plurality of rollers 9, three in the present example, mounted on spindles 9′ equally spaced about the periphery of the ring. Corresponding rollers of the two rings are shown mounted on a common spindle 9′ which is journaled in a suitable support, not shown. If desired, the rollers of the two rings may be individually mounted. The rings 10 and 11 are not only supported for free rotation on the rollers 9 but also are positioned laterally thereby and for this purpose each is provided with the groove 12, which is shown for example as V-shaped and engaged by the rollers 9 having a correspondingly shaped periphery. It is obvious that instead of rollers 9, the rings might be supported by means of balls running in ball races. The film is shown pressed against the faces of the rings by the pressure rolls 14 and 15. From the pressure roll 15 the film passes to the drum 16, thence over the idlers 17 and 18 to the drive sprocket 5. Secured to the shaft of drum 16 is a suitable fly wheel 19 whose inertia prevents the transmission to the reproducing point of small speed variations of sprocket 5, such for example as those due to improper sprocket action. In my copending application to which reference has been made above, I have described and claimed means by which a certain amount of driving torque is applied to the drum and flywheel from the driving motor. A further filtering of sprocket tooth vibrations is effected by the natural resilience of the film between idlers 17 and 18.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. In apparatus for recording sound on or reproducing sound from a moving film, a freely rotatable cylindrical member adapted to support the film at the recording or reproducing point and supporting means for said member comprising a plurality of rotat-

able members engaging the periphery of said member.

2. In apparatus for recording sound on or reproducing sound from a moving film, a freely rotatable ring arranged to support the film at the recording or reproducing point, means for pressing the film against the ring, and supporting means for said ring comprising a plurality of rotatable members having fixed centers arranged to engage the surface of the ring.

3. Apparatus for reproducing sound from a film record comprising a pair of spaced freely rotatable rings arranged to support the film at the point of reproduction and to engage it at opposite sides of the sound record thereon, a member for directing a light beam through the sound record, and a member for receiving the light passing through the sound record one of said members being arranged within one of the rings.

4. Apparatus for reproducing sound from a film record comprising a pair of coaxial rings spaced to engage the film at opposite sides of the record thereon and arranged to support the film at the point of reproduction, a plurality of rollers having fixed centers rotatably mounting said rings, means for focusing a beam of light on that part of the film supported by the rings and a photo-electric cell arranged within one of the rings.

5. Apparatus for reproducing sound from a film record comprising a pair of similar coaxial rings spaced to engage the film at opposite sides of the record thereon and arranged to support the film at the point of reproduction, said rings having guide grooves on their periphery, a plurality of supporting rollers engaging the grooves in said rings, means for focusing a beam of light on the film between the rings, and a photo-electric cell arranged within one of the rings.

In witness whereof, I have hereunto set my hand this 3rd day of October, 1929.

EDWARD W. KELLOGG.

PLAINTIFFS' EXHIBIT NO. 52.

United States Patent No. 1,808,551.

June 2, 1931. C. L. HEISLER 1,808,551

FILM DRIVING

Filed Aug. 11, 1927 2 Sheets-Sheet 1

Fig. 1.

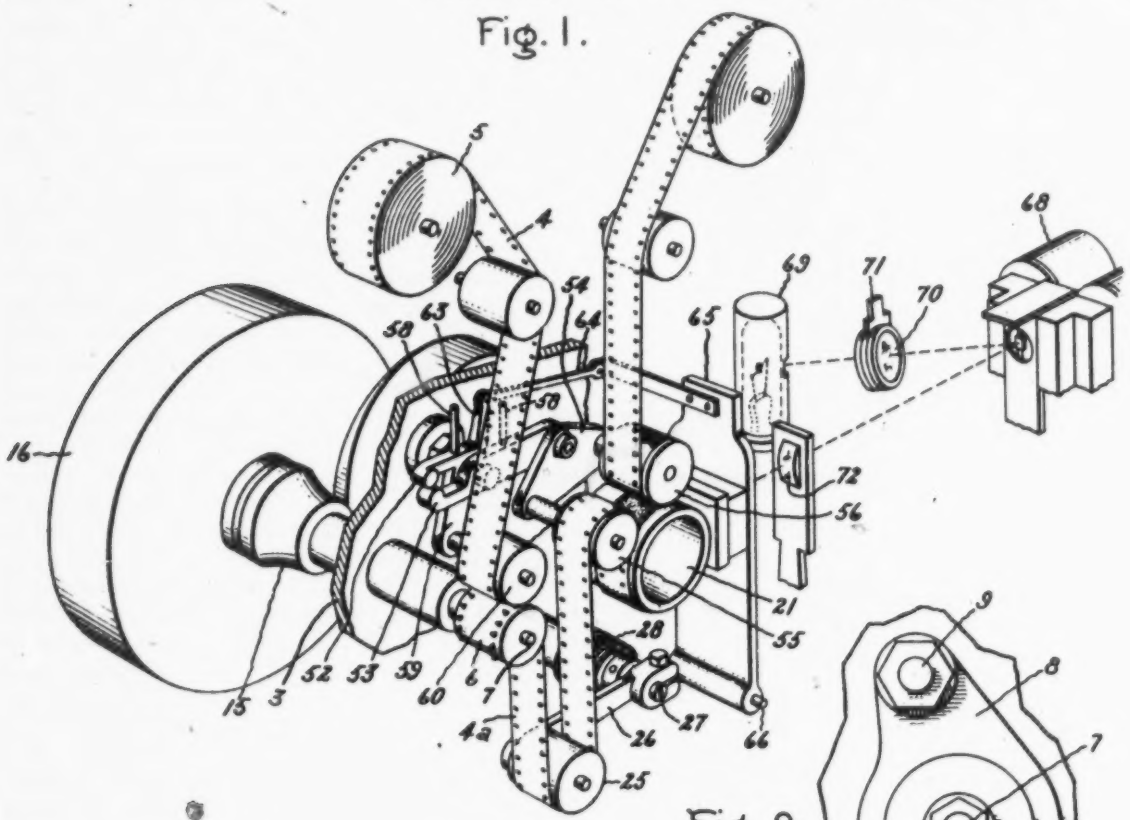


Fig. 9.

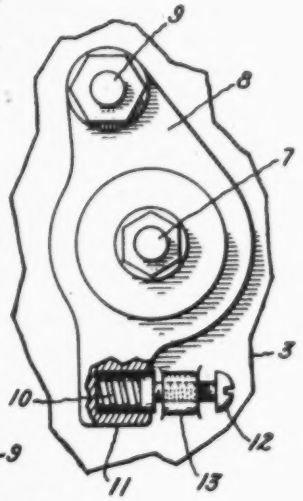
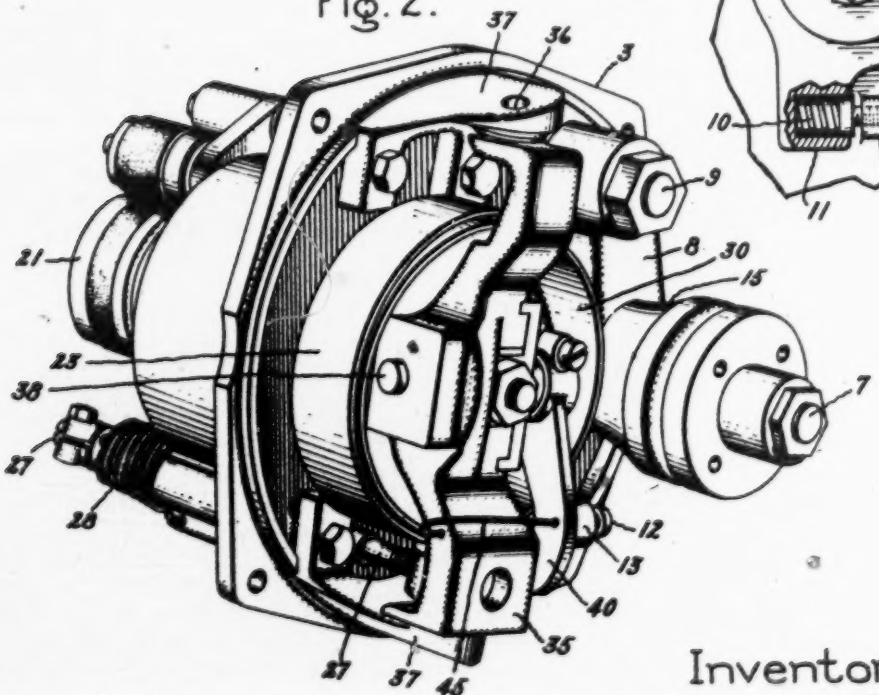


Fig. 2.



Inventor:
Charles L. Heisler

June 2, 1931. C. L. HEISLER 1,808,551

FILM DRIVING

Filed Aug. 11, 1927 2 Sheets-Sheet 1

Fig. 1.

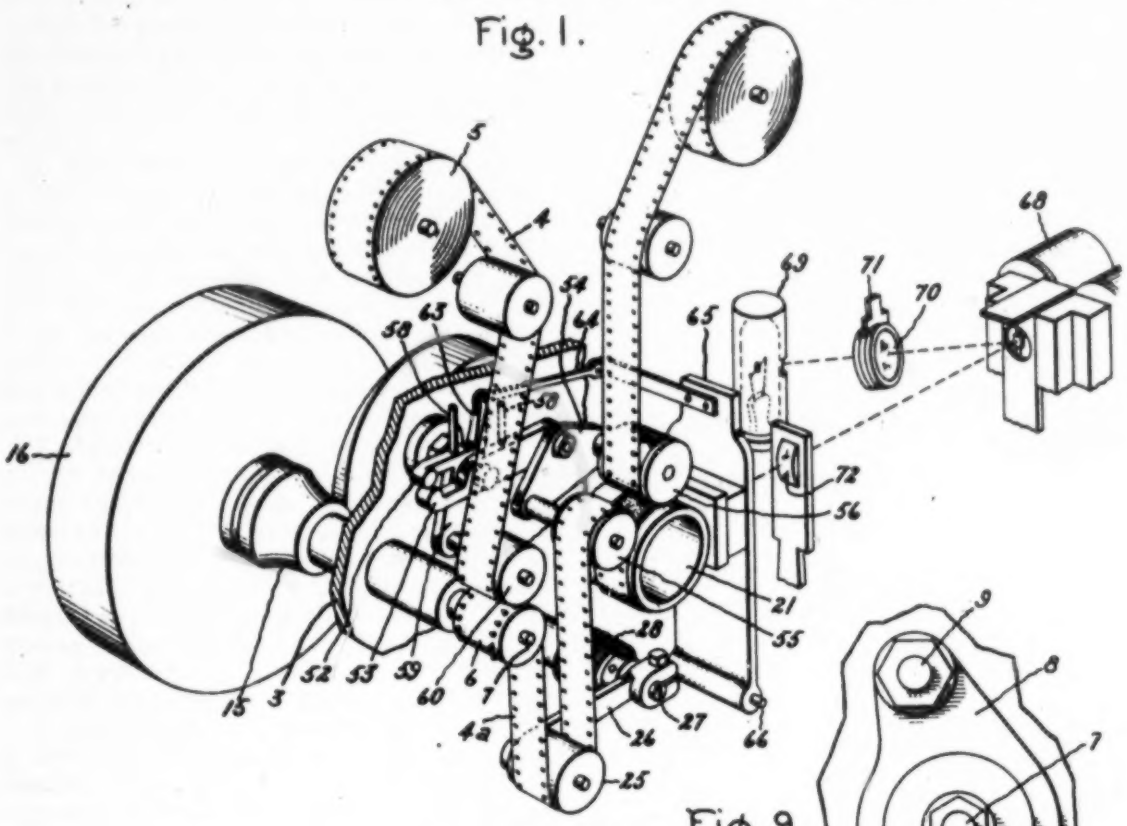


Fig. 9.

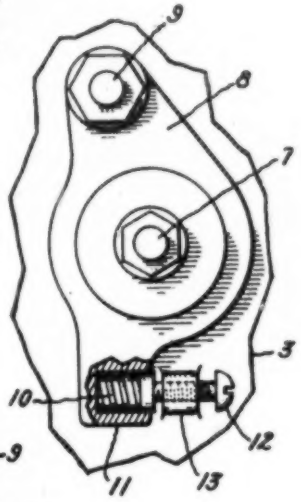
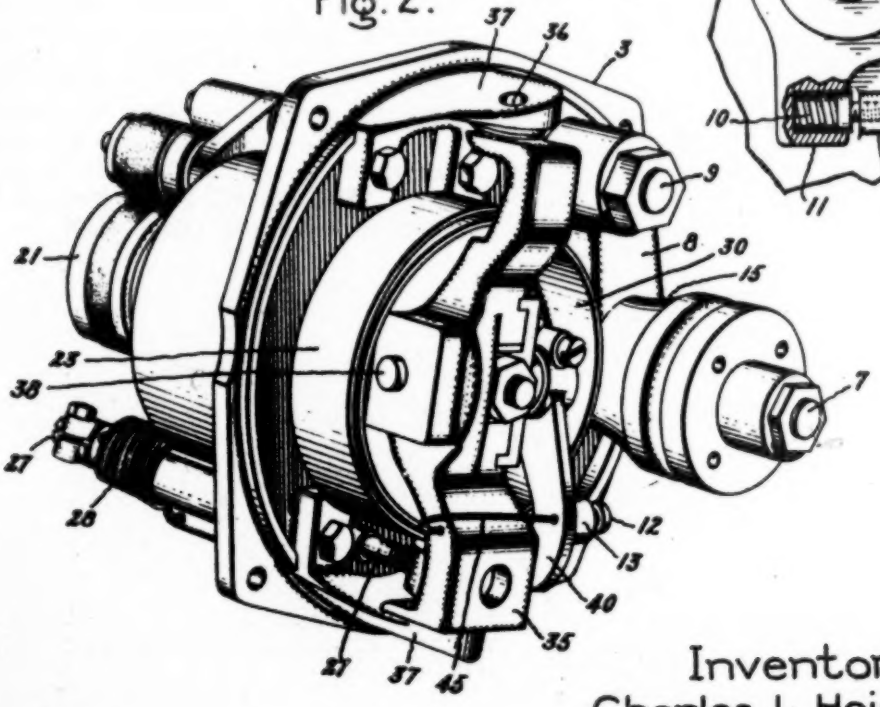


Fig. 2.



Inventor:
Charles L. Heisler,
by Alexander S. Lamb.
His Attorney.

490

June 2, 1931. C. L. HEISLER 1,808,551

FILM DRIVING

Filed Aug. 11, 1927 2 Sheets-Sheet 2

Fig. 3.

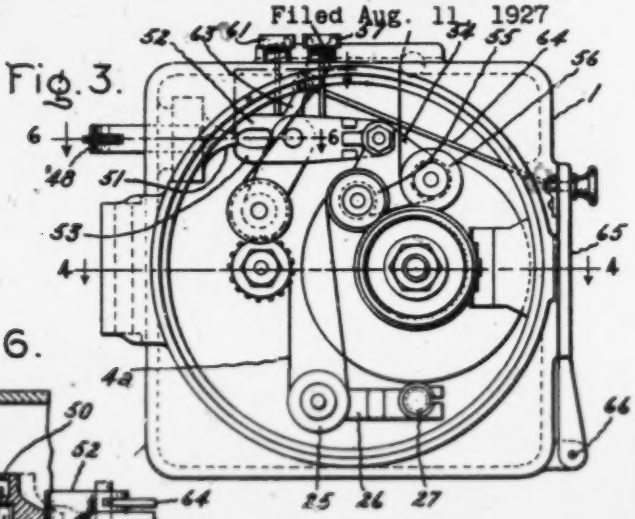


Fig. 7.

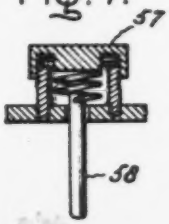


Fig. 6.

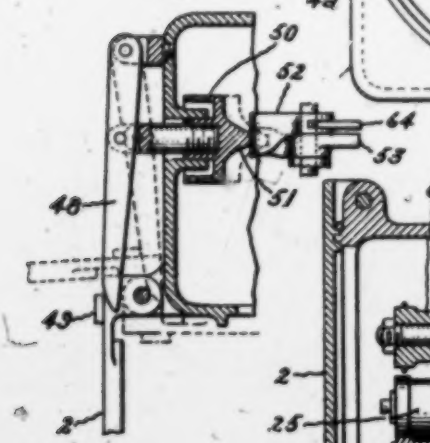


Fig. 4.

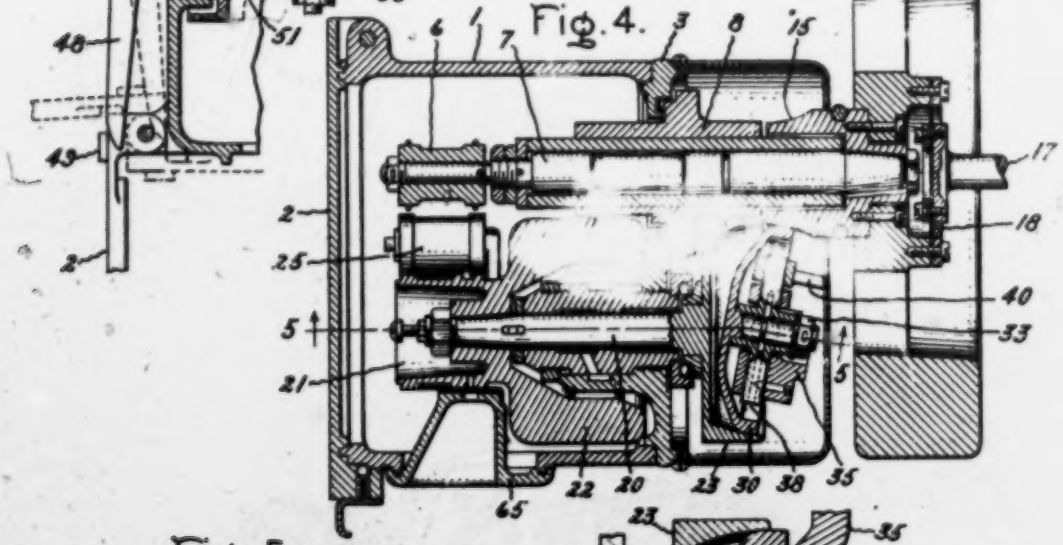


Fig. 5.

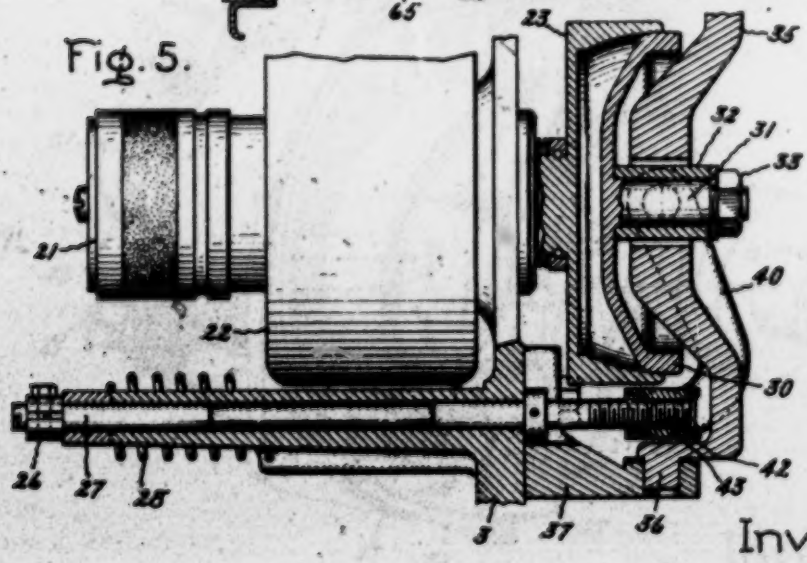
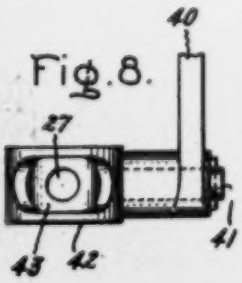


Fig. 8.



Inventor:
Charles L. Heisler.

Patented June 2, 1931

491
1,808,551

UNITED STATES PATENT OFFICE

CHARLES L. HEISLER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

FILM DRIVING

Application filed August 11, 1927. Serial No. 212,349.

My invention relates to the recording of sound on a film and the reproduction of the sound from a film record. A convenient manner of making a sound film record is to expose a moving light-sensitive film, such for example as a motion picture film, to a light beam which is caused to vary in intensity or position in accordance with the sound waves to be recorded. For moving the film it is usual to provide the film with a row of sprocket tooth openings along each edge which openings are engaged by the teeth on suitable sprocket wheels over which the film is led in passing from one reel to the other as in motion picture apparatus. For moving the film where it is exposed to the variable light beam in the recording process and for moving the film bearing the sound record when it is passed through a constant light beam in the reproducing process I have found it desirable to employ a belt-type drive rather than a sprocket drive, and for this purpose I use a smooth faced wheel or drum rather than a sprocket wheel and rotate it at a substantially uniform speed. When both drum and sprocket wheels are connected to be driven from a common driving member, I have found it to be very difficult to construct the wheel or drum having a diameter of such exactness that the film will be moved by the wheel or drum at exactly the same linear speed as it is moved by the sprocket wheels. Even if such exactness were practicable the loop of film formed between the drum and a sprocket wheel would invariably gradually increase or gradually decrease as the film is passed from one reel to the other, because of well known imperfections in sprocket transmitting actions. If conditions are such that the loop continues to decrease until it disappears and the film is drawn tight, a certain amount of slipping of the film over the drum is bound to occur. On the contrary, if the loop continues to increase, it is proper synchronism between the pictures and the reproduced sounds depends upon the uniformity of the distance measured along the film between the sound reproducer and the picture projector.

Shrinkage of the film due to developing and age also seriously affect the relative rates at which it is passed by the sprockets and the drum. It will readily be seen that a shrunken film will be moved by the sprockets at a slower linear speed than one which has not shrunk, hence there is a tendency for the loop between the drum and a sprocket at one side of the drum to steadily decrease until it is drawn tight and is forced to slip over the drum and for the loop between the drum and a sprocket on the other side of the drum to steadily increase.

One object of my invention is to provide an improved method of, and means for, moving a sound record film by means of both sprocket and belt-type drives whereby the above mentioned difficulties are avoided. Another object of my invention is to provide an improved means for separating the film engaging means, whereby threading of the film through the apparatus is facilitated.

In accordance with my present invention I operate the film driving sprocket or sprockets at a substantially constant speed and operate the belt-type drive for the film at approximately the same speed, but vary the speed of the belt-type drive when necessary in such a manner that the film is moved at the same rate by both drives. For the purpose of illustration I have chosen to show my invention as comprising a portion of a sound recording apparatus. It will be understood, however, that my invention is not limited to such, but is applicable also to the apparatus by which the sound recorded on a film is reproduced.

My invention will be better understood from the following description taken in connection with the accompanying drawing

FILM DRIVING

Filed Aug. 11, 1927 2 Sheets-Sheet 2

Fig. 3.

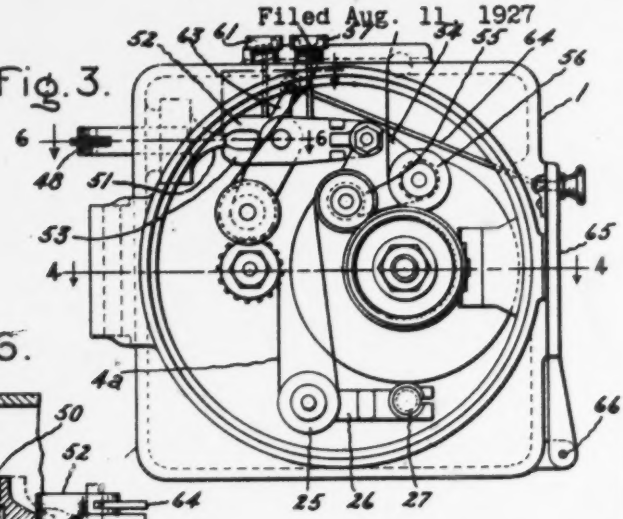


Fig. 7.

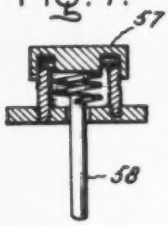


Fig. 6.

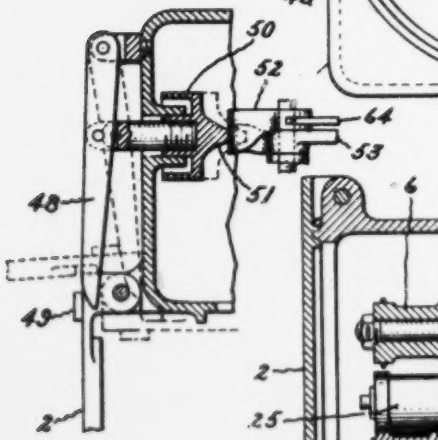


Fig. 4.

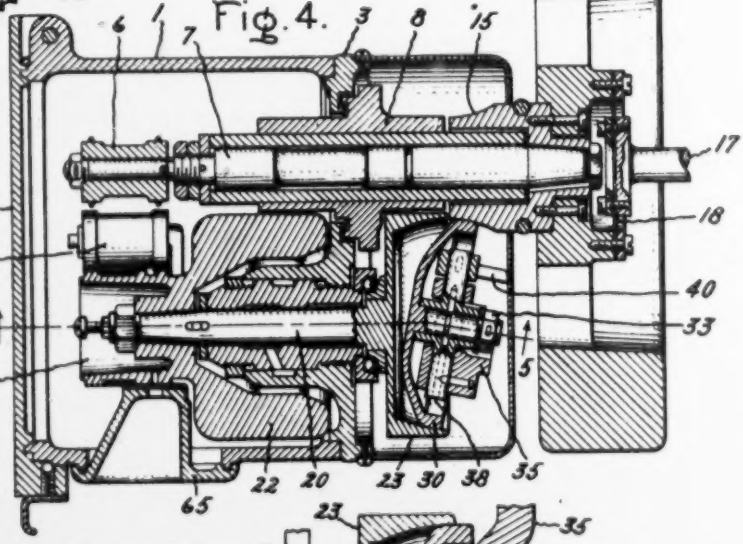


Fig. 5.

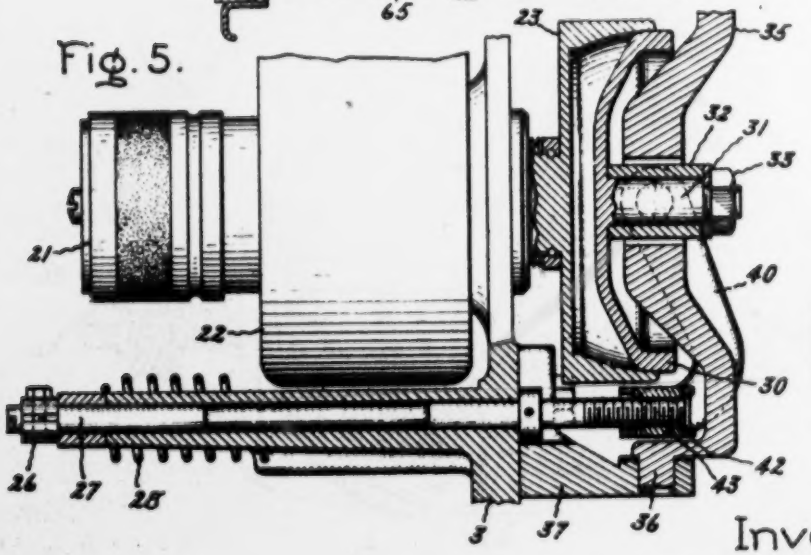
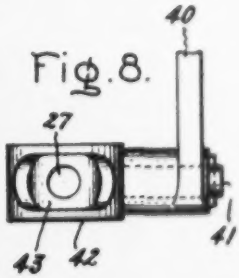


Fig. 8.



Inventor:
Charles L. Heisler,
by Alexander S. Lowe
His Attorney.

UNITED STATES PATENT OFFICE

CHARLES L. HEISLER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

FILM DRIVING

Application filed August 11, 1927. Serial No. 212,349.

My invention relates to the recording of sound on a film and the reproduction of the sound from a film record. A convenient manner of making a sound film record is to expose a moving light-sensitive film, such for example as a motion picture film, to a light beam which is caused to vary in intensity or position in accordance with the sound waves to be recorded. For moving the film it is usual to provide the film with a row of sprocket tooth openings along each edge which openings are engaged by the teeth on suitable sprocket wheels over which the film is led in passing from one reel to the other as in motion picture apparatus. For moving the film where it is exposed to the variable light beam in the recording process and for moving the film bearing the sound record when it is passed through a constant light beam in the reproducing process I have found it desirable to employ a belt-type drive rather than a sprocket drive, and for this purpose I use a smooth faced wheel or drum rather than a sprocket wheel and rotate it at a substantially uniform speed. When both drum and sprocket wheels are connected to be driven from a common driving member, I have found it to be very difficult to construct the wheel or drum having a diameter of such exactness that the film will be moved by the wheel or drum at exactly the same linear speed as it is moved by the sprocket wheels. Even if such exactness were practicable the loop of film formed between the drum and a sprocket wheel would invariably gradually increase or gradually decrease as the film is passed from one reel to the other, because of well known imperfections in sprocket transmitting actions. If conditions are such that the loop continues to decrease until it disappears and the film is drawn tight, a certain amount of slipping of the film over the drum is bound to occur. On the contrary, if the loop continues to increase, it is liable to become tangled up in the apparatus and be broken. The evil results of such increase and decrease in the size of the loop are still worse in the case of a combined motion picture and sound record film where proper synchronism between the pictures and the reproduced sounds depends upon the uniformity of the distance measured along the film between the sound reproducer and the picture projector.

Shrinkage of the film due to developing and age also seriously affect the relative rates at which it is passed by the sprockets and the drum. It will readily be seen that a shrunken film will be moved by the sprockets at a slower linear speed than one which has not shrunk, hence there is a tendency for the loop between the drum and a sprocket at one side of the drum to steadily decrease until it is drawn tight and is forced to slip over the drum and for the loop between the drum and a sprocket on the other side of the drum to steadily increase.

One object of my invention is to provide an improved method of, and means for, moving a sound record film by means of both sprocket and belt-type drives whereby the above mentioned difficulties are avoided. Another object of my invention is to provide an improved means for separating the film engaging means, whereby threading of the film through the apparatus is facilitated.

In accordance with my present invention I operate the film driving sprocket or sprockets at a substantially constant speed and operate the belt-type drive for the film at approximately the same speed, but vary the speed of the belt-type drive when necessary in such a manner that the film is moved at the same rate by both drives. For the purpose of illustration I have chosen to show my invention as comprising a portion of a sound recording apparatus. It will be understood, however, that my invention is not limited to such, but is applicable also to the apparatus by which the sound recorded on a film is reproduced.

My invention will be better understood from the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

Referring to the drawings, Figs. 1 and 2 are perspective views of the apparatus with the enclosing casing removed as viewed from

opposite sides thereof; Fig. 3 is an end view corresponding to Fig. 1; Fig. 4 is a transverse sectional view on the line 4—4 of Fig. 3; Fig. 5 is a fragmentary sectional view on line 5—5 of Fig. 4 drawn to a larger scale; Fig. 6 is a fragmentary sectional view on line 6—6 of Fig. 3; and Figs. 7, 8 and 9 illustrate details.

In the drawings the enclosing casing 1 has a door 2 at one end giving access to the film and film engaging wheels and an end head or frame 3 at the other end by which the moving parts are supported. The film 4 is drawn from the reel 5 by the sprocket wheel 6 fixed to shaft 7 which is journalled in an adjustable bearing member 8, this member and the frame 3 being provided with cooperating flanges to constitute a suitable light trap. Bearing member 8 is pivoted to frame 3 at 9 and by means of the spring 10 mounted in the lug 11 and the adjusting screw 12 threaded in the lug 13 the shaft 7 carried by this member is resiliently moved to the left as viewed in Figs. 2 and 9 for a purpose to be described herein after. Shaft 7 has secured to it the friction wheel 15 to which the fly wheel 16 is shown secured. Drive shaft 17 is shown connected to the fly wheel by a vibration absorbing coupling which for example may comprise a leather disk 18.

Journalled in the frame 3 is the shaft 20 upon one end of which is fixed the film engaging drum 21 which is shown as having an enlarged portion 22 forming a fly wheel. On the opposite end of shaft 20 is the friction wheel 23 which is driven from friction wheel 15 through a variable speed mechanism now to be described. As was pointed out above, if the film is driven both by the sprocket 6 and the drum 21 and not allowed to slip on the drum, the loop of film 4a between the sprocket and drum will either increase or decrease in size due to the fact that the two drives will not pass the film at exactly the same speed. I have provided the idler 25 to engage the loop of film and mount the idler on the arm 26 fixed to shaft 27 which is journalled in frame 3. A light spring 28 rotates the shaft 27 and arm 26 so as to take up the slack in the film loop and maintain a constant tension in the film as it is fed to the drum 21. Any slight variation in the position of the arm 26 due to changes in the size of the loop changes the speed of the drum 21 relative to the speed of the sprocket. Rotative movement is communicated to friction wheel 23 by which the drum is rotated from friction wheel 15 through friction wheel 30. This wheel is fixed on the stud 31 which is freely rotat-

contact path on the periphery of the friction wheels 15 and 23, thereby varying the relative speed at which the drum is driven. This mounting comprises the rocking member 35 having trunnions 36 at opposite ends journalled in the brackets 37 secured to the frame 3. Bearing sleeve 32 is pivotally mounted in the rocking member 35 by means of the trunnions 38 thereon. Secured to one of the trunnions 38 is the arm 40 in whose opposite end is journalled the stud 41 of the retaining member 42 for the cylindrical nut 43. The nut is threaded on the end of shaft 27 and through the retaining member has universal movement relative to the arm 40. The contacting surfaces of friction wheels 15, 23 and 30 are curved such that a driving connection is provided therebetween and as the wheel 30 is tilted more or less from the position illustrated in Fig. 4 its engaging tracks on the other two wheels vary inversely in their diameter. An important feature of the construction is the arrangement whereby the wheel 30 is not forcibly slid over the surfaces of the cooperating wheels 15 and 23 but is caused to roll to its new position by virtue of the rocking movement on the axis of trunnions 38 given to the wheel by the arm 40. An extremely light controlling force only is thereby required to produce a desired change in speed of the drum, hence a very light spring 28 may be employed and only slight changes in tension of the film in the loop are produced. In Fig. 2 I have shown a small spring 45 between member 35 and arm 40 to take up any back lash.

For convenience in threading the film through the machine I have provided means automatically operable upon movement of the door 2 to a predetermined open position for separating the various wheels between which the film is clamped. This means, best shown in Figs. 1, 3 and 6 comprises a lever 48 fulcrumed to the enclosing casing and adapted to be engaged by the bar 49 extending up from the hinge portion of the door 2. The bar 49 is so positioned that the door may be opened to a right angle position without the bar moving the lever, thus giving access to the film and engaging mechanism without interfering with their operations. If it is desired to rethread the film, the door, which is omitted in Fig. 3, is swung open farther when the bar 49 moves the lever inward. Within the casing and connected to the lever by a rod is the spreader 50 having a wedge-shaped nose 51, opposite sides of which engage the levers 52 and 53 pivotally supported at a common point Lever 53 pivotally supports at its opposite

presses the idlers 55 and 56 against the drum with the film interposed. The other lever 52 has a depending arm 59 on which is pivoted the idler 60 and this lever is resiliently held by adjustable spring means 61 similar to that described for lever 53 in a position to cause the idler 60 to clamp the film against the sprocket 6. Lever 52 also has an arm 63 which by link 64 connects with the aperture holding member 65. The latter is pivotally supported at 66 and carries a narrow light aperture which is arranged close to the film on the drum and through which light is admitted to the film. By this construction it will be seen that when the door 48 is swung wide open, the spreader 50 by the rocking levers 52 and 53 moves idlers 55 and 56 away from the drum 21, moves idler 60 away from sprocket 6 and moves aperture holding member 65 away from the drum. A film may then be easily and quickly threaded. This part of my invention I have claimed in my copending application, Serial No. 312,391, filed October 13, 1928.

In Fig. 1, I have shown the apparatus arranged to record sound on the film, electric vibrations from a suitable pick-up device, not shown, actuating the mirror of the oscillograph 68 to oscillate a beam of light from the source 69 on the aperture in member 65. In the path of its beam I have shown the condensing lens 70 having the diaphragm 71 and the cylindrical lens 72. While I have illustrated my invention as applied to recording apparatus it is not limited thereto but is equally applicable to reproducing apparatus where for example a steady narrow beam of light is thrown on the film record and a photo-electric cell is placed behind the film as it passes over the drum.

The apparatus which I have disclosed may be used alone for recording sound on or for reproducing sound from a film or may be used in conjunction with a motion picture camera or motion picture projector, in which case the film may bear both sound and picture records and pass successively through the sound and picture apparatus on its journey from the unwinding reel to the winding reel.

In the latter case where sound and picture apparatus are combined it is found desirable for obtaining proper synchronism to employ a sprocket such as that shown at 6 and operatively connected to the picture apparatus to feed the film to the drum 21. Under certain conditions, such as where the sound apparatus is used alone, a belt-type drive may be substituted for the sprocket 6 which drive takes the varying load incident tion and it will be apparent that various modifications may be made without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. The method of moving the film in a sound recording or in a sound reproducing apparatus having a common driving member and a sprocket drive and a belt-type drive connected therewith and arranged in successive engagement with the film which comprises operating the sprocket drive at the same angular speed as the driving member independent of the load and varying the connection of the driving member with the belt-type drive in accordance with the length of film between the two drives.

2. Apparatus for recording sound on or for reproducing sound from a film comprising a sprocket drive and a belt-type drive arranged simultaneously to engage the film, common operating means for said drives, means devoid of slippage for connecting the operating means with the sprocket drive, and means responsive to the length of film between said drives for varying the speed at which the belt-type drive is operated by said operating means.

3. Apparatus for recording sound on or for reproducing sound from a film comprising a plurality of drives for the film including a toothed wheel and a smooth faced wheel, a common operating means therefor having a connection with each of said drives, the connection with the toothed wheel being non-slippable, and means arranged in the connection with said smooth faced wheel for automatically regulating the speed thereof in accordance with the length of film between the drives to cause said drives to move the film at equal speeds.

4. Apparatus for recording sound on or for reproducing sound from a film comprising a shaft, a sprocket drive for the film having a positive non-slippable drive connection with the shaft, a drum over which the film passes, a variable speed connection between the shaft and drum, and means responsive to the length of film between the sprocket and the drum for controlling said connection.

5. Apparatus of the character described comprising a sprocket and a drum arranged to engage a film serially, a variable speed connection between the sprocket and the drum comprising a plurality of wheels having contact surfaces of variable diameter and an oscillatably mounted wheel engaging the contact surfaces of said wheels and

corresponding to Fig. 1; Fig. 4 is a transverse sectional view on the line 4—4 of Fig. 3; Fig. 5 is a fragmentary sectional view on line 5—5 of Fig. 4 drawn to a larger scale; Fig. 6 is a fragmentary sectional view on line 6—6 of Fig. 3; and Figs. 7, 8 and 9 illustrate details.

In the drawings the enclosing casing 1 has a door 2 at one end giving access to the film and film engaging wheels and an end head or frame 3 at the other end by which the moving parts are supported. The film 4 is drawn from the reel 5 by the sprocket wheel 6 fixed to shaft 7 which is journalled in an adjustable bearing member 8, this member and the frame 3 being provided with cooperating flanges to constitute a suitable light trap. Bearing member 8 is pivoted to frame 3 at 9 and by means of the spring 10 mounted in the lug 11 and the adjusting screw 12 threaded in the lug 13 the shaft 7 carried by this member is resiliently moved to the left as viewed in Figs. 2 and 9 for a purpose to be described herein after. Shaft 7 has secured to it the friction wheel 15 to which the fly wheel 16 is shown secured. Drive shaft 17 is shown connected to the fly wheel by a vibration absorbing coupling which for example may comprise a leather disk 18.

Journalled in the frame 3 is the shaft 20 upon one end of which is fixed the film engaging drum 21 which is shown as having an enlarged portion 22 forming a fly wheel. On the opposite end of shaft 20 is the friction wheel 23 which is driven from friction wheel 15 through a variable speed mechanism now to be described. As was pointed out above, if the film is driven both by the sprocket 6 and the drum 21 and not allowed to slip on the drum, the loop of film 4a between the sprocket and drum will either increase or decrease in size due to the fact that the two drives will not pass the film at exactly the same speed. I have provided the idler 25 to engage the loop of film and mount the idler on the arm 26 fixed to shaft 27 which is journalled in frame 3. A light spring 28 rotates the shaft 27 and arm 26 so as to take up the slack in the film loop and maintain a constant tension in the film as it is fed to the drum 21. Any slight variation in the position of the arm 26 due to changes in the size of the loop changes the speed of the drum 21 relative to the speed of the sprocket. Rotative movement is communicated to friction wheel 23 by which the drum is rotated from friction wheel 15 through friction wheel 30. This wheel is fixed on the stud 31 which is freely rotatable in the sleeve 32 being retained by the nut 33. Sleeve 32 has a gimbal joint mounting whereby the angular position of the wheel 30 may be varied thus changing its tion wheels 15 and 23, thereby varying the relative speed at which the drum is driven. This mounting comprises the rocking member 35 having trunnions 36 at opposite ends journalled in the brackets 37 secured to the frame 3. Bearing sleeve 32 is pivotally mounted in the rocking member 35 by means of the trunnions 38 thereon. Secured to one of the trunnions 38 is the arm 40 in whose opposite end is journalled the stud 41 of the retaining member 42 for the cylindrical nut 43. The nut is threaded on the end of shaft 27 and through the retaining member has universal movement relative to the arm 40. The contacting surfaces of friction wheels 15, 23 and 30 are curved such that a driving connection is provided therebetween and as the wheel 30 is tilted more or less from the position illustrated in Fig. 4 its engaging tracks on the other two wheels vary inversely in their diameter. An important feature of the construction is the arrangement whereby the wheel 30 is not forcibly slid over the surfaces of the cooperating wheels 15 and 23 but is caused to roll to its new position by virtue of the rocking movement on the axis of trunnions 38 given to the wheel by the arm 40. An extremely light controlling force only is thereby required to produce a desired change in speed of the drum, hence a very light spring 28 may be employed and only slight changes in tension of the film in the loop are produced. In Fig. 2 I have shown a small spring 45 between member 35 and arm 40 to take up any back lash.

For convenience in threading the film through the machine I have provided means automatically operable upon movement of the door 2 to a predetermined open position for separating the various wheels between which the film is clamped. This means, best shown in Figs. 1, 3 and 6 comprises a lever 48 fulcrumed to the enclosing casing and adapted to be engaged by the bar 49 extending up from the hinge portion of the door 2. The bar 49 is so positioned that the door may be opened to a right angle position without the bar moving the lever, thus giving access to the film and engaging mechanism without interfering with their operations. If it is desired to rethread the film, the door, which is omitted in Fig. 3, is swung open farther when the bar 49 moves the lever inward. Within the casing and connected to the lever by a rod is the spreader 50 having a wedge-shaped nose 51, opposite sides of which engage the levers 52 and 53 pivotally supported at a common point. Lever 53 pivotally supports at its opposite end the plate 54 which carries the pivot pins of the idlers 55 and 56. By the adjustable spring mounting 57, shown enlarged in Fig. 7, the rod 58 engaging lever 53 resiliently

presses the idlers 55 and 56 against the drum with the film interposed. The other lever 52 has a depending arm 59 on which is pivoted the idler 60 and this lever is resiliently held by adjustable spring means 61 similar to that described for lever 53 in a position to cause the idler 60 to clamp the film against the sprocket 6. Lever 52 also has an arm 63 which by link 64 connects with the aperture holding member 65. The latter is pivotally supported at 66 and carries a narrow light aperture which is arranged close to the film on the drum and through which light is admitted to the film. By this construction it will be seen that when the door 48 is swung wide open, the spreader 50 by the rocking levers 52 and 53 moves idlers 55 and 56 away from the drum 21, moves idler 60 away from sprocket 6 and moves aperture holding member 65 away from the drum. A film may then be easily and quickly threaded. This part of my invention I have claimed in my copending application, Serial No. 312,391, filed October 13, 1928.

In Fig. 1, I have shown the apparatus arranged to record sound on the film, electric vibrations from a suitable pick-up device, not shown, actuating the mirror of the oscillograph 68 to oscillate a beam of light from the source 69 on the aperture in member 65. In the path of its beam I have shown the condensing lens 70 having the diaphragm 71 and the cylindrical lens 72. While I have illustrated my invention as applied to recording apparatus it is not limited thereto but is equally applicable to reproducing apparatus where for example a steady narrow beam of light is thrown on the film record and a photo-electric cell is placed behind the film as it passes over the drum.

The apparatus which I have disclosed may be used alone for recording sound on or for reproducing sound from a film or may be used in conjunction with a motion picture camera or motion picture projector, in which case the film may bear both sound and picture records and pass successively through the sound and picture apparatus on its journey from the unwinding reel to the winding reel.

In the latter case where sound and picture apparatus are combined it is found desirable for obtaining proper synchronism to employ a sprocket such as that shown at 6 and operatively connected to the picture apparatus to feed the film to the drum 21. Under certain conditions, such as where the sound apparatus is used alone, a belt-type drive may be substituted for the sprocket 6 which drive takes the varying load incident to withdrawing the film from the unwinding reel.

I have chosen the particular embodiment described above as illustrative of my invention and it will be apparent that various modifications may be made without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. The method of moving the film in a sound recording or in a sound reproducing apparatus having a common driving member and a sprocket drive and a belt-type drive connected therewith and arranged in successive engagement with the film which comprises operating the sprocket drive at the same angular speed as the driving member independent of the load and varying the connection of the driving member with the belt-type drive in accordance with the length of film between the two drives.

2. Apparatus for recording sound on or for reproducing sound from a film comprising a sprocket drive and a belt-type drive arranged simultaneously to engage the film, common operating means for said drives, means devoid of slippage for connecting the operating means with the sprocket drive, and means responsive to the length of film between said drives for varying the speed at which the belt-type drive is operated by said operating means.

3. Apparatus for recording sound on or for reproducing sound from a film comprising a plurality of drives for the film including a toothed wheel and a smooth faced wheel, a common operating means therefor having a connection with each of said drives, the connection with the toothed wheel being non-slippable, and means arranged in the connection with said smooth faced wheel for automatically regulating the speed thereof in accordance with the length of film between the drives to cause said drives to move the film at equal speeds.

4. Apparatus for recording sound on or for reproducing sound from a film comprising a shaft, a sprocket drive for the film having a positive non-slippable drive connection with the shaft, a drum over which the film passes, a variable speed connection between the shaft and drum, and means responsive to the length of film between the sprocket and the drum for controlling said connection.

5. Apparatus of the character described comprising a sprocket and a drum arranged to engage a film serially, a variable speed connection between the sprocket and the drum comprising a plurality of wheels having contact surfaces of variable diameter and an oscillatably mounted wheel engaging the contact surfaces of said wheels, and means controlled by the length of film between the sprocket and drum for oscillating the latter wheel.

6. Apparatus of the character described

comprising a sprocket and a drum arranged to engage a film serially, a driving connection therebetween comprising a pair of wheels having contact surfaces of variable diameter connected respectively with said sprocket and said drum and a third wheel engaging the contact surfaces of said pair of wheels and having a gimbal mounting whereby oscillation of the axis of said third wheel causes said third wheel to change its line of contact with each of said pair of wheels.

7. Apparatus of the character described comprising two driving members arranged to engage a film serially, and a variable speed connection between said members comprising a plurality of friction wheels of varying diameter and an intermediate friction wheel cooperating therewith having an axis angularly adjustable to cause the wheel to change the line of contact made by it on the other friction wheels.

8. Apparatus of the character described comprising two driving members arranged to engage a film serially, and a variable speed connection between said members comprising friction wheels of varying diameter and having fixed mountings and a cooperating friction wheel having its axis angularly adjustable on an axis passing through its points of contact with said friction wheels whereby its rotation automatically causes it to vary its lines of contact with said wheels.

9. Apparatus of the character described comprising a sprocket and a drum arranged to engage a film serially, means for driving one of said members, a variable speed driving connection between said members, comprising a plurality of members having curved friction surfaces of varying diameter, an intermediate friction wheel arranged to contact therewith and means for supporting said wheel for movement on each of two axes at right angles to each other and to the axis of the wheel, and means responsive to a change in the length of film between said members for adjusting the friction wheel on one of said axes.

In witness whereof, I have hereunto set my hand this 10th day of August, 1927.

CHARLES L. HEISLER.

PLAINTIFFS' EXHIBIT NO. 53.

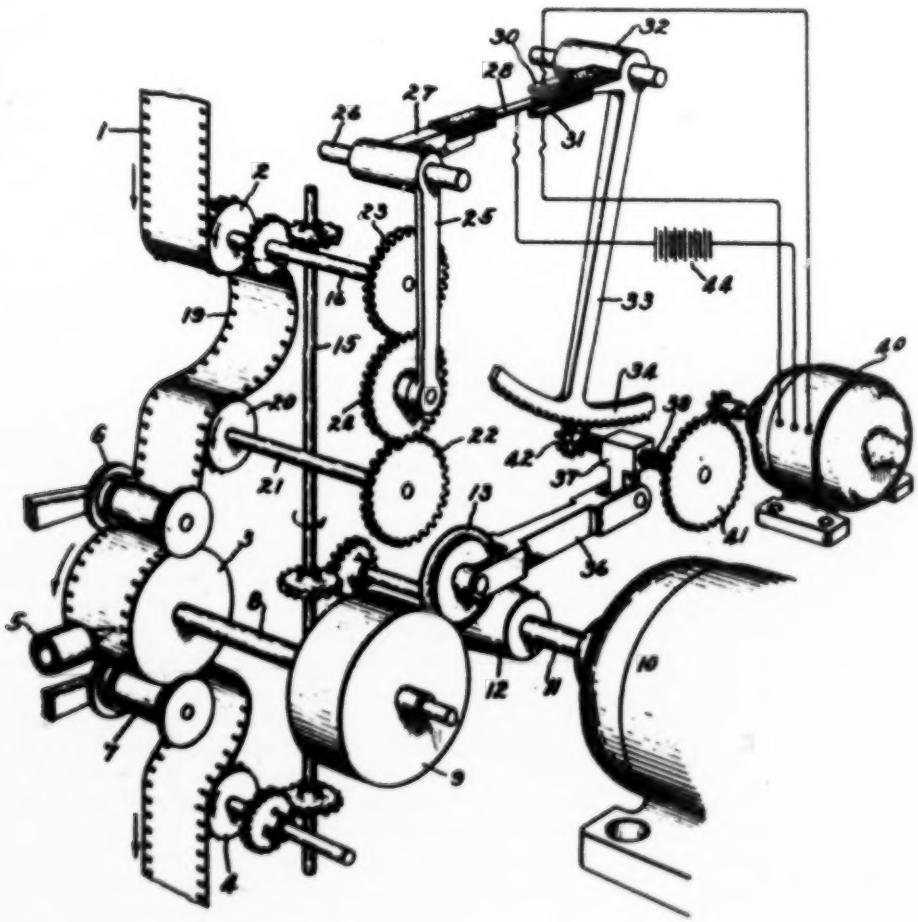
United States Patent No. 1,827,588.

496

Oct. 13, 1931. E. W. KELLOGG 1,827,588

FILM DRIVE

Filed Nov. 29, 1929



Inventor

Edward W. Kellogg,

by Church & Thomas

Patented Oct. 13, 1931

1,827,588

497

UNITED STATES PATENT OFFICE

EDWARD W. KELLOGG, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

FILM DRIVE

Application filed November 29, 1929. Serial No. 410,284.

My invention relates to apparatus for recording sound on or reproducing sound from a film of the motion picture type. More particularly it relates to that part of the apparatus by which the film is supported and driven at a uniform speed.

When the sound recording or reproduction is done independently of the taking or the projection of motion pictures, as, for example, in a film phonograph, a film devoid of sprocket tooth openings may be used, and driven by means of smooth faced rollers. However, when the sound record is intended to be reproduced in synchronism with motion pictures it is usual to employ a film having sprocket tooth openings, such as is used for motion pictures, and to drive the film by sprockets which are geared or otherwise connected to the sprockets of the picture apparatus so as to have a definite speed relation therewith whereby exact synchronism is insured at all times between the pictures and the sounds. In the photographic recording of sound on a film and in the reproduction of sound from a film record it has been found necessary for the best results to cause the film to move past the light beam with a speed which to a high degree of perfection is free from all variations and which closely approaches a condition of absolute uniformity. A common source of speed variation of the film at the point of light interception is the vibration set up in the film as a result of improper sprocket tooth action such as occurs when, due to changes in length of the film, the pitch of the sprocket tooth openings is not exactly equal to the pitch of the sprocket teeth. To avoid film vibration due to this cause certain forms of apparatus have been constructed to support and move the film at the point of the light interception by a smooth faced roller or drum which is driven at a uniform speed, a sprocket or sprockets being also employed in the apparatus to insure the proper synchronism of movement of the film as has already been explained. With such an arrangement it has been found necessary to maintain some tension on the film to cause it to move the same amount of film in the same time without slippage of the film on the drum. It is the object of my invention to provide an improved film driving apparatus in which the film is driven jointly by a sprocket and a roller or drum and in which the speed of one of said members is varied in accordance with the amount of film moved by the respective members as determined by the number of film sprocket holes.

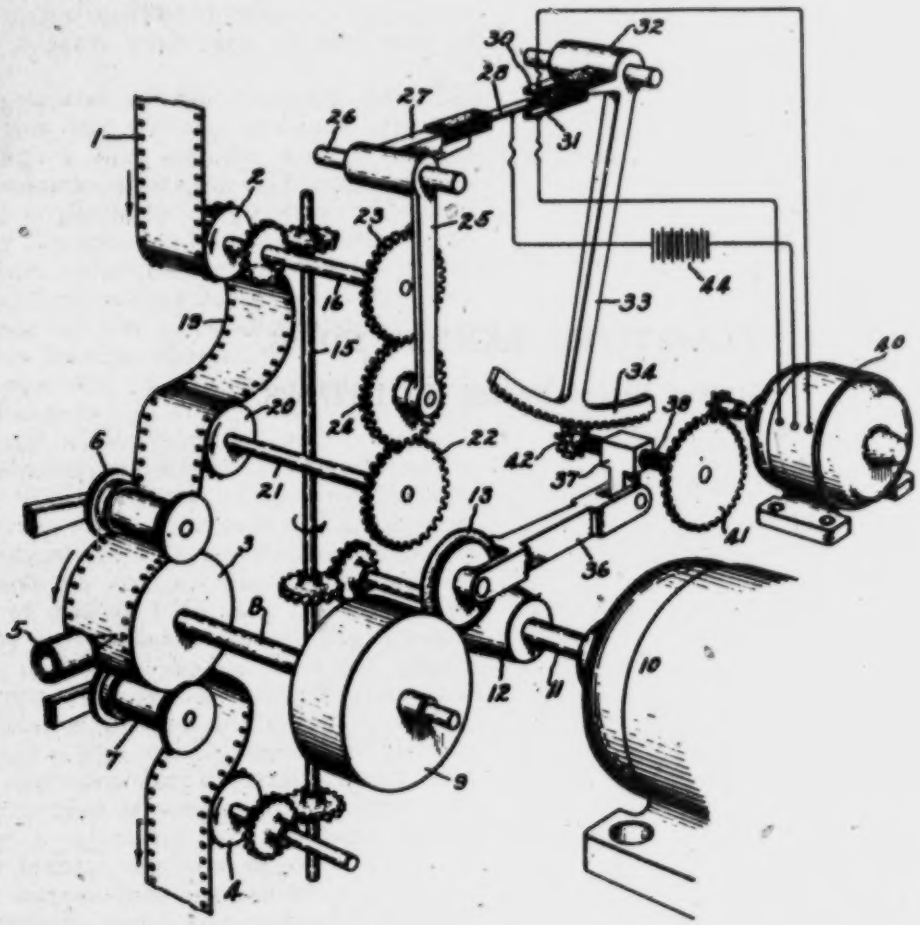
Briefly, my invention comprises in the form illustrated, a free running sprocket hole counter engaging that portion of the film moved by the drum and a variable speed driving mechanism for the drum controlled by the relative movement of a drive sprocket and the sprocket hole counter.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing in which the single figure is a diagrammatic representation of a preferred embodiment of my invention, the film 1 is shown driven jointly by the sprocket 2, the drum 3 and the sprocket 4, which elements the film engages serially in its passage downward through the apparatus. While my invention is applicable equally to a sound recorder and a sound reproducer, I have chosen to illustrate it as forming a part of a recorder. Accordingly, the exposing light directed on the film by the optical system 5 is caused to vary in accordance with the sound waves, the film being firmly supported and moved at a uniform speed at the point of light interception by the drum 3. It will be understood that the member 3 is essentially only a smooth faced wheel or roller but which on account of its relative size I have termed a drum. The film is pressed against its face by the two pressure rolls 6 and 7 and mounted on the same shaft 8 therewith is the driving cylinder 9. Driving motor 10 has on its shaft 11 the cone 12 and engaging the cone and cylinder is the

FILM DRIVE

Filed Nov. 29, 1929



Inventor
Edward W. Kellogg,
by Charles E. Mullen
His Attorney.

UNITED STATES PATENT OFFICE

EDWARD W. KELLOGG, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

FILM DRIVE

Application filed November 29, 1929. Serial No. 410,284.

My invention relates to apparatus for recording sound on or reproducing sound from a film of the motion picture type. More particularly it relates to that part of the apparatus by which the film is supported and driven at a uniform speed.

When the sound recording or reproduction is done independently of the taking or the projection of motion pictures, as, for example, in a film phonograph, a film devoid of sprocket tooth openings may be used, and driven by means of smooth faced rollers. However, when the sound record is intended to be reproduced in synchronism with motion pictures it is usual to employ a film having sprocket tooth openings, such as is used for motion pictures, and to drive the film by sprockets which are geared or otherwise connected to the sprockets of the picture apparatus so as to have a definite speed relation therewith whereby exact synchronism is insured at all times between the pictures and the sounds. In the photographic recording of sound on a film and in the reproduction of sound from a film record it has been found necessary for the best results to cause the film to move past the light beam with a speed which to a high degree of perfection is free from all variations and which closely approaches a condition of absolute uniformity. A common source of speed variation of the film at the point of light interception is the vibration set up in the film as a result of improper sprocket tooth action such as occurs when, due to changes in length of the film, the pitch of the sprocket tooth openings is not exactly equal to the pitch of the sprocket teeth. To avoid film vibration due to this cause certain forms of apparatus have been constructed to support and move the film at the point of the light interception by a smooth faced roller or drum which is driven at a uniform speed, a sprocket or sprockets being also employed in the apparatus to insure the proper synchronism of movement of the film as has already been explained. With such an arrangement it has been found necessary to employ some means of varying the relative speeds of the sprocket and the drum in order that they shall both move the same amount of film in the same time without slippage of the film on the drum. It is the object of my invention to provide an improved film driving apparatus in which the film is driven jointly by a sprocket and a roller or drum and in which the speed of one of said members is varied in accordance with the amount of film moved by the respective members as determined by the number of film sprocket holes.

Briefly, my invention comprises in the form illustrated, a free running sprocket hole counter engaging that portion of the film moved by the drum and a variable speed driving mechanism for the drum controlled by the relative movement of a drive sprocket and the sprocket hole counter.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing in which the single figure is a diagrammatic representation of a preferred embodiment of my invention, the film 1 is shown driven jointly by the sprocket 2, the drum 3 and the sprocket 4, which elements the film engages serially in its passage downward through the apparatus. While my invention is applicable equally to a sound recorder and a sound reproducer, I have chosen to illustrate it as forming a part of a recorder. Accordingly, the exposing light directed on the film by the optical system 5 is caused to vary in accordance with the sound waves, the film being firmly supported and moved at a uniform speed at the point of light interception by the drum 3. It will be understood that the member 3 is essentially only a smooth faced wheel or roller but which on account of its relative size I have termed a drum. The film is pressed against its face by the two pressure rolls 6 and 7 and mounted on the same shaft 8 therewith is the driving cylinder 9. Driving motor 10 has on its shaft 11 the cone 12 and engaging the cone and cylinder is the axially movable rubber tired wheel 13. Shaft 11 is geared to the vertical shaft 15 which also is geared to rotate shaft 16 on

which sprocket 2 is secured and is geared to the shaft to which sprocket 4 is secured. By this arrangement it will be seen that the two sprockets 2 and 4 are positively geared to the motor while the drum is rotated thereby through a variable speed connection.

The means by which the variable speed connection to the drum is controlled will now be described. Engaging the film directly above the drum 3 where it is drawn by the drum from the loop 19 is the sprocket hole counter 20 which is illustrated as a free running sprocket of the same diameter as sprocket 2. Mounted on the same shaft 21 with the counter 20 is the gear 22 and a like gear 23 is mounted on shaft 16. Meshing with gears 22 and 23 is gear 24 which is rotatably mounted on the end of the rocker arm 25 pivoted on shaft 26. A second arm 27 on this member supports the contact 28 which is positioned between and is adapted to engage either contact 30 or 31. The two latter contacts are supported by the pivoted member 32 having on the end of arm 33 the gear segment 34. The purpose of making the contacts 30 and 31 movable will be explained in a later paragraph. For a preliminary understanding of the principle of operation of the device, they may be regarded for the present as stationary contacts. Various means may be provided for shifting the position of the wheel 13 which by its position controls the speed of the drum. I have shown one such means for convenience as the carrier 36 at one end of which is mounted the wheel 13 and at the other end of which is pivoted the nut 37 engaging screw 38 which is driven in one direction or the other by the auxiliary motor 40 through suitable gearing shown at 41. Motor 40 is shown connected in circuit with the battery 44, the direction of rotation depending upon whether contact 28 engages contact 30 or contact 31. It will be understood that the drawing illustrating my invention is diagrammatic in character, many structural features common to such apparatus such as a supporting frame work, a casing and magazines for enclosing the film, pressure rolls for the sprockets, etc., having been omitted for the sake of greater clearness in illustrating the invention.

In the operation of the apparatus the film is driven jointly by the sprockets 2 and 4 and the drum 3. If the speed of the drum is such that the film moved thereby rotates the sprocket hole counter 20 the same amount as the sprocket 2 is rotated by the motor then the axis of the intermediate gear 24 will remain stationary and in the position illustrated, motor 40 being open circuited. If the number of sprocket tooth openings passing the counter 20 rotates it through a slightly left closing the circuit of motor 40 through contacts 28 and 31. The resulting rotation of the motor 40 shifts the wheel 13 to the right where it will engage a portion of the cone 12 which is of smaller diameter and hence will rotate the drum 3 at a less speed. The converse takes place if the drum moves a less number of sprocket holes than sprocket 2 in a given time in which case the intermediate gear is shifted to the right. The motor is then energized through contacts 28 and 30 and is rotated in the opposite direction so that the drum is caused to have an increase in speed. It will be understood that the amount of movement of the axis of the intermediate gear 24 is slight and never is such that it seriously interferes with the proper meshing of this gear with gears 22 and 23. This differential gear and the sprocket hole counter are of light construction so that they offer but little resistance to the movement of the film.

The mechanism as so far described would serve to cause an increase in drum speed when the counter sprocket 20 lags behind the sprocket 2 in phase, and conversely to decrease the drum speed if the counter sprocket 20 advances in phase with respect to sprocket 2. The purpose of making contacts 30 and 31 movable will now be described. Were these contacts stationary there would be tendency for the drum speed to "hunt" or run for a while at too high a speed and then at too low a speed, repeating this cycle many times. If the drum, for example, has been running too fast, and the gear 24 has thereby been shifted to the left, causing contact point 28 to touch 31, motor 40 will operate to reduce the drum speed, but gear 24 will not begin to return to normal position until the speed has been reduced to such a point that the counter sprocket 20 runs slower than sprocket 2. By the time the contact between 28 and 31 is broken the speed will be too low, and a correction in the reverse direction will be required. Such hunting is prevented by causing contacts 30 and 31 to be moved whenever the roller 13 is shifted. Provision for this movement is shown in the pinion 42 which meshes with a gear sector 34 on the bell crank 32 one arm of which carries the contacts 30 and 31. Thus when the motor 40 operates it not only shifts nut 37 with the carriage 36 and roller 13, but also moves the contacts 30 and 31. The movement of these contacts is in such a direction as to tend to break whichever circuit is closed, and thus stop the motor 40. Assume now that the drum has been running too fast and gear 24 has been moved to the left with consequent closing of contact 31. Motor 40 will then operate to shift roller 13 to the right, thus reducing the drum speed, and at the same time it will move the gear sector 34 to

has been reduced to the correct value, the counter sprocket 20 will continue to gain in phase as compared with sprocket 2, the gear 24 will be moved still farther to the left, and contact 31 will again be closed, and a further correction will be made, this process repeating until the correct speed is reached. In fact, the action may be continuous without any break in the circuit until the speed is equalized. If the motor 40 is very quick in its action it may break its own circuit several times before the correction is completed. On the other hand if the motor is sluggish the circuit may not be broken until the correction has been carried a little too far, and then a reverse correction will take place, but the desired equilibrium will be established with one or two reversals, and no serious tendency to hunt will be displayed.

Instead of recording directly on the drum 3 as illustrated it may be found desirable to draw the film by means of the drum through a gate of suitable construction. Similarly in a reproducing apparatus the drum may have a different construction to accommodate a photo-electric cell or the film may be drawn by the drum through a suitable gate. There are also many possible modifications of the differential gearing system, any one of which modifications can be made to register changes in phase between sprockets 20 and 2. It is obvious that a sprocket engaging the film is not the only possible device for connecting sprocket holes, that an electrical contact making counter, for example, might be arranged to perform the necessary function, but I have chosen the sprocket for illustration since it constitutes a very simple form of counter.

It will be apparent that various modifications may be made in the embodiment of my invention which I have described and illustrated without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. Apparatus for driving a film having sprocket tooth openings therein comprising a sprocket member and a drum member arranged in successive engagement with the film, driving means for said sprocket and drum members, and means responsive to a difference in speed of those portions of the film moved by the respective sprocket and drum members as determined by the sprocket tooth openings and independently of the length of film between said members for varying the speed of one of said members.

2. Apparatus for driving a film having sprocket tooth openings therein comprising a sprocket member and a member having a smooth periphery arranged for successive engagement with the film, a sprocket hole [illegible] it is moved by the latter member, and means responsive to a predetermined relative movement of said sprocket and counter for varying the speed of one of said members.

3. Apparatus for driving a film having sprocket tooth openings therein comprising a sprocket and a drum arranged for successive engagement with the film, driving means therefor, a sprocket hole counter arranged to engage the film where it is moved by the drum, and means responsive to the difference in the number of sprocket holes passing said counter and said sprocket, for varying the speed of one of said members.

4. Apparatus for driving a film having sprocket tooth openings therein comprising a sprocket member and a drum member arranged for successive engagement with the film, a common driving member for said members, a sprocket hole counter arranged to engage the film where it is moved by the drum member, a variable speed drive connection between the driving member and the drum member and mechanism responsive to a predetermined change in angular position of said sprocket member and counter for controlling said variable speed driving connection.

5. Apparatus for driving a film provided with sprocket tooth openings comprising a sprocket and a drum arranged for successive engagement with the film, a motor having driving connections with said sprocket and drum, a sprocket driven by the film at a point where the film is moved by the drum, said driving connections including a variable speed connection with said drum and means operatively connected with both of said sprockets for controlling the variable speed connection in response to a predetermined difference in movement of the sprockets.

6. Apparatus for driving a film provided with sprocket tooth openings comprising sprocket and drum members arranged for successive engagement with the film, a motor having driving connections with said sprocket and drum members, a sprocket driven by the film at a point where the film is moved by the drum member, said driving connections including a variable speed connection with one of said members for correcting the speed of said one member, means operatively connected with both of said sprockets for controlling the variable speed connection in response to a predetermined difference in movement of the sprockets, and means responsive to the operation of the variable speed connection for preventing an over-correction of the speed of said one member.

7. Apparatus for driving a film provided with sprocket tooth openings comprising a sprocket and a drum arranged for successive engagement with the film, a motor having a

which sprocket 2 is secured and is geared to the shaft to which sprocket 4 is secured. By this arrangement it will be seen that the two sprockets 2 and 4 are positively geared to the motor while the drum is rotated thereby through a variable speed connection.

The means by which the variable speed connection to the drum is controlled will now be described. Engaging the film directly above the drum 3 where it is drawn by the drum from the loop 19 is the sprocket hole counter 20 which is illustrated as a free running sprocket of the same diameter as sprocket 2. Mounted on the same shaft 21 with the counter 20 is the gear 22 and a like gear 23 is mounted on shaft 16. Meshing with gears 22 and 23 is gear 24 which is rotatably mounted on the end of the rocker arm 25 pivoted on shaft 26. A second arm 27 on this member supports the contact 28 which is positioned between and is adapted to engage either contact 30 or 31. The two latter contacts are supported by the pivoted member 32 having on the end of arm 33 the gear segment 34. The purpose of making the contacts 30 and 31 movable will be explained in a later paragraph. For a preliminary understanding of the principle of operation of the device, they may be regarded for the present as stationary contacts. Various means may be provided for shifting the position of the wheel 13 which by its position controls the speed of the drum. I have shown one such means for convenience as the carrier 36 at one end of which is mounted the wheel 13 and at the other end of which is pivoted the nut 37 engaging screw 38 which is driven in one direction or the other by the auxiliary motor 40 through suitable gearing shown at 41. Motor 40 is shown connected in circuit with the battery 44, the direction of rotation depending upon whether contact 28 engages contact 30 or contact 31. It will be understood that the drawing illustrating my invention is diagrammatic in character, many structural features common to such apparatus such as a supporting frame work, a casing and magazines for enclosing the film, pressure rolls for the sprockets, etc., having been omitted for the sake of greater clearness in illustrating the invention.

In the operation of the apparatus the film is driven jointly by the sprockets 2 and 4 and the drum 3. If the speed of the drum is such that the film moved thereby rotates the sprocket hole counter 20 the same amount as the sprocket 2 is rotated by the motor then the axis of the intermediate gear 24 will remain stationary and in the position illustrated, motor 40 being open circuited. If the number of sprocket tooth openings passing the counter 20 rotates it through a slightly greater angle than the angle rotated by sprocket 2 in a given time the position of the intermediate gear 24 will be shifted to the left closing the circuit of motor 40 through contacts 28 and 31. The resulting rotation of the motor 40 shifts the wheel 13 to the right where it will engage a portion of the cone 12 which is of smaller diameter and hence will rotate the drum 3 at a less speed. The converse takes place if the drum moves a less number of sprocket holes than sprocket 2 in a given time in which case the intermediate gear is shifted to the right. The motor is then energized through contacts 28 and 30 and is rotated in the opposite direction so that the drum is caused to have an increase in speed. It will be understood that the amount of movement of the axis of the intermediate gear 24 is slight and never is such that it seriously interferes with the proper meshing of this gear with gears 22 and 23. This differential gear and the sprocket hole counter are of light construction so that they offer but little resistance to the movement of the film.

The mechanism as so far described would serve to cause an increase in drum speed when the counter sprocket 20 lags behind the sprocket 2 in phase, and conversely to decrease the drum speed if the counter sprocket 20 advances in phase with respect to sprocket 2. The purpose of making contacts 30 and 31 movable will now be described. Were these contacts stationary there would be tendency for the drum speed to "hunt" or run for a while at too high a speed and then at too low a speed, repeating this cycle many times. If the drum, for example, has been running too fast, and the gear 24 has thereby been shifted to the left, causing contact point 28 to touch 31, motor 40 will operate to reduce the drum speed, but gear 24 will not begin to return to normal position until the speed has been reduced to such a point that the counter sprocket 20 runs slower than sprocket 2. By the time the contact between 28 and 31 is broken the speed will be too low, and a correction in the reverse direction will be required. Such hunting is prevented by causing contacts 30 and 31 to be moved whenever the roller 13 is shifted. Provision for this movement is shown in the pinion 42 which meshes with a gear sector 34 on the bell crank 32 one arm of which carries the contacts 30 and 31. Thus when the motor 40 operates it not only shifts nut 37 with the carriage 36 and roller 13, but also moves the contacts 30 and 31. The movement of these contacts is in such a direction as to tend to break whichever circuit is closed, and thus stop the motor 40. Assume now that the drum has been running too fast and gear 24 has been moved to the left with consequent closing of contact 31. Motor 40 will then operate to shift roller 13 to the right, thus reducing the drum speed, and at the same time it will move the gear sector 34 to the right and lower contact 31 until the circuit is broken, thus stopping the motor. If the motor stops before the speed of the drum

phase as compared with sprocket 2, the gear 24 will be moved still farther to the left, and contact 31 will again be closed, and a further correction will be made, this process repeating until the correct speed is reached. In fact, the action may be continuous without any break in the circuit until the speed is equalized. If the motor 40 is very quick in its action it may break its own circuit several times before the correction is completed. On the other hand if the motor is sluggish the circuit may not be broken until the correction has been carried a little too far, and then a reverse correction will take place, but the desired equilibrium will be established with one or two reversals, and no serious tendency to hunt will be displayed.

Instead of recording directly on the drum 3 as illustrated it may be found desirable to draw the film by means of the drum through a gate of suitable construction. Similarly in a reproducing apparatus the drum may have a different construction to accommodate a photo-electric cell or the film may be drawn by the drum through a suitable gate. There are also many possible modifications of the differential gearing system, any one of which modifications can be made to register changes in phase between sprockets 20 and 2. It is obvious that a sprocket engaging the film is not the only possible device for connecting sprocket holes, that an electrical contact making counter, for example, might be arranged to perform the necessary function, but I have chosen the sprocket for illustration since it constitutes a very simple form of counter.

It will be apparent that various modifications may be made in the embodiment of my invention which I have described and illustrated without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. Apparatus for driving a film having sprocket tooth openings therein comprising a sprocket member and a drum member arranged in successive engagement with the film, driving means for said sprocket and drum members, and means responsive to a difference in speed of those portions of the film moved by the respective sprocket and drum members as determined by the sprocket tooth openings and independently of the length of film between said members for varying the speed of one of said members.

2. Apparatus for driving a film having sprocket tooth openings therein comprising a sprocket member and a member having a smooth periphery arranged for successive engagement with the film, a sprocket hole counter arranged to engage said film where responsive to a predetermined relative movement of said sprocket and counter for varying the speed of one of said members.

3. Apparatus for driving a film having sprocket tooth openings therein comprising a sprocket and a drum arranged for successive engagement with the film, driving means therefor, a sprocket hole counter arranged to engage the film where it is moved by the drum, and means responsive to the difference in the number of sprocket holes passing said counter and said sprocket, for varying the speed of one of said members.

4. Apparatus for driving a film having sprocket tooth openings therein comprising a sprocket member and a drum member arranged for successive engagement with the film, a common driving member for said members, a sprocket hole counter arranged to engage the film where it is moved by the drum member, a variable speed drive connection between the driving member and the drum member and mechanism responsive to a predetermined change in angular position of said sprocket member and counter for controlling said variable speed driving connection.

5. Apparatus for driving a film provided with sprocket tooth openings comprising a sprocket and a drum arranged for successive engagement with the film, a motor having driving connections with said sprocket and drum, a sprocket driven by the film at a point where the film is moved by the drum, said driving connections including a variable speed connection with said drum and means operatively connected with both of said sprockets for controlling the variable speed connection in response to a predetermined difference in movement of the sprockets.

6. Apparatus for driving a film provided with sprocket tooth openings comprising sprocket and drum members arranged for successive engagement with the film, a motor having driving connections with said sprocket and drum members, a sprocket driven by the film at a point where the film is moved by the drum member, said driving connections including a variable speed connection with one of said members for correcting the speed of said one member, means operatively connected with both of said sprockets for controlling the variable speed connection in response to a predetermined difference in movement of the sprockets, and means responsive to the operation of the variable speed connection for preventing an over-correction of the speed of said one member.

7. Apparatus for driving a film provided with sprocket tooth openings comprising a sprocket and a drum arranged for successive engagement with the film, a motor having a gear connection with said sprocket, and having a variable speed connection with said

drum, a sprocket driven by the film at a point where the film is moved by the drum, a differential gear mechanism having gears rotated respectively by said sprockets and an intermediate gear meshing therewith, contact mechanism controlled by the position of said intermediate gear and means controlled by said contact mechanism for operating said variable speed connection.

8. Apparatus for driving a film provided with sprocket tooth openings comprising a sprocket and a drum arranged for successive engagement with the film, a motor connected to drive the sprocket, a variable speed connection between the motor and the drum including a speed controlling device for correcting the speed of the drum, a sprocket driven by the film at a point where the film is moved by the drum, a differential gear mechanism between said sprockets, means controlled by said differential gear mechanism for moving said speed controlling device, and means responsive to the movement of said device for causing the speed correcting action of said variable speed connection to cease before the phase relation between said sprockets returns to that at which the correcting action started.

In witness whereof, I have hereunto set my hand this 27th day of November, 1929.

EDWARD W. KELLOGG.

PLAINTIFFS' EXHIBIT NO. 54.

Copy of File Wrapper and Contents of Heisler Patent No. 1,831,562.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 55.

United States Patent No. 1,839,151.

504

Dec. 29, 1931. C. L. HEISLER 1,839,151

SOUND REPRODUCING APPARATUS

Filed Sept. 25, 1929 2 Sheets-Sheet 1

Fig. 1.

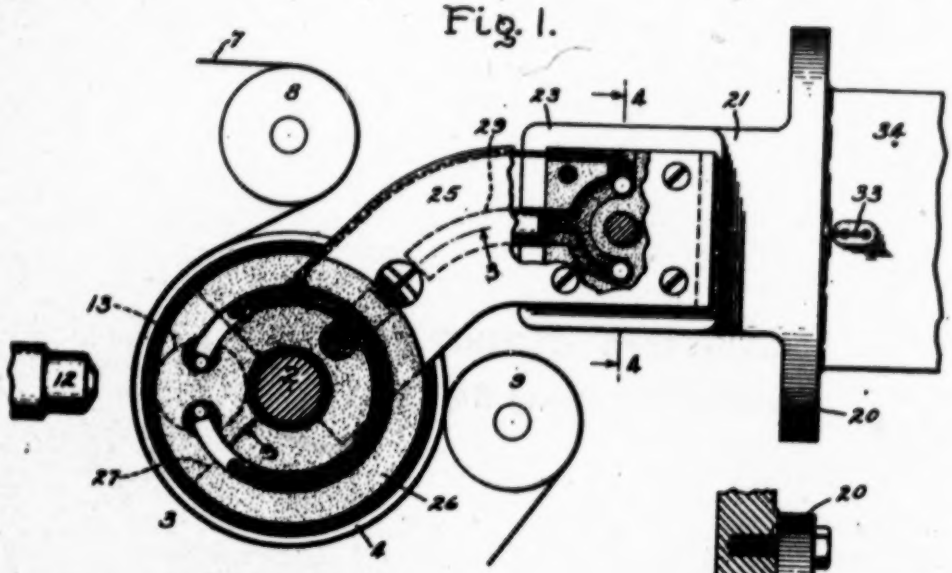
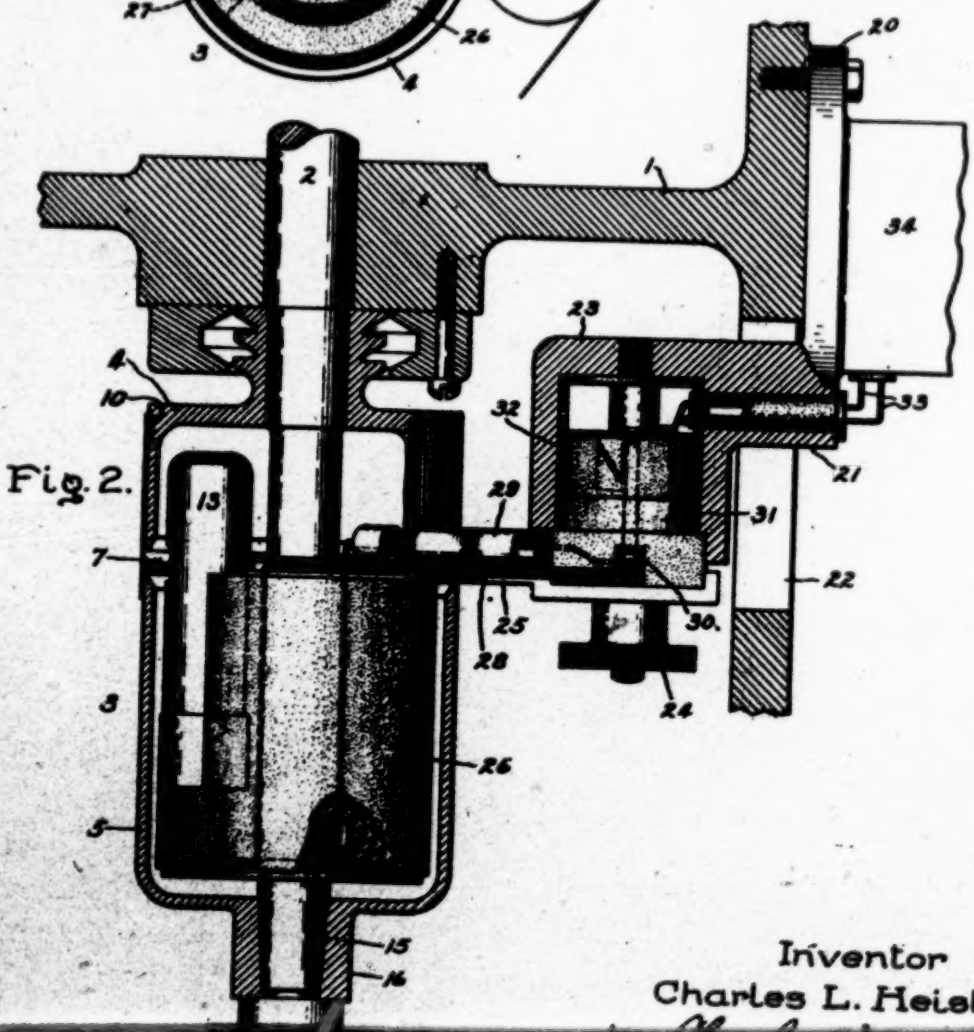


Fig. 2.



Inventor
Charles L. Heisler,

Dec. 29, 1931. C. L. HEISLER 1,839,151

SOUND REPRODUCING APPARATUS

Filed Sept. 25, 1929 2 Sheets-Sheet 1

Fig. 1.

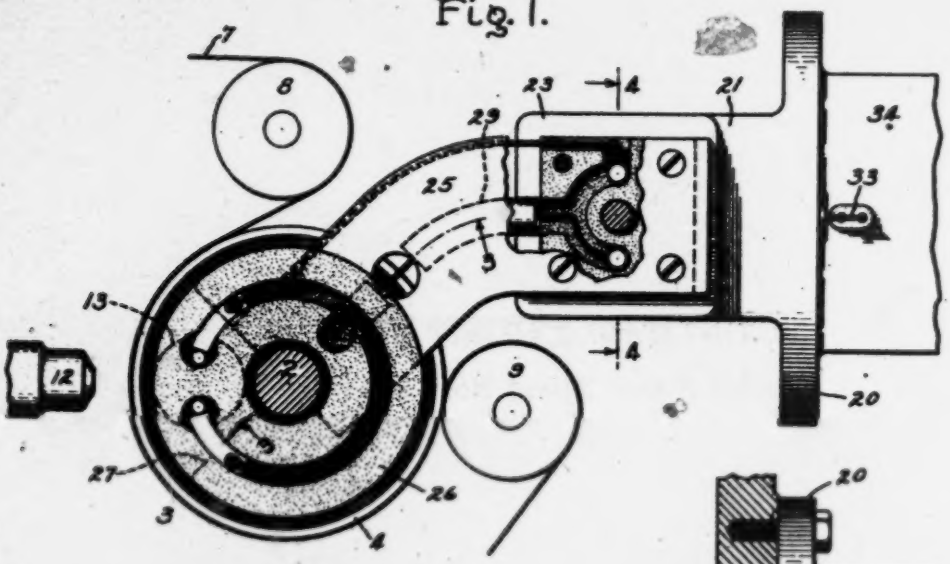
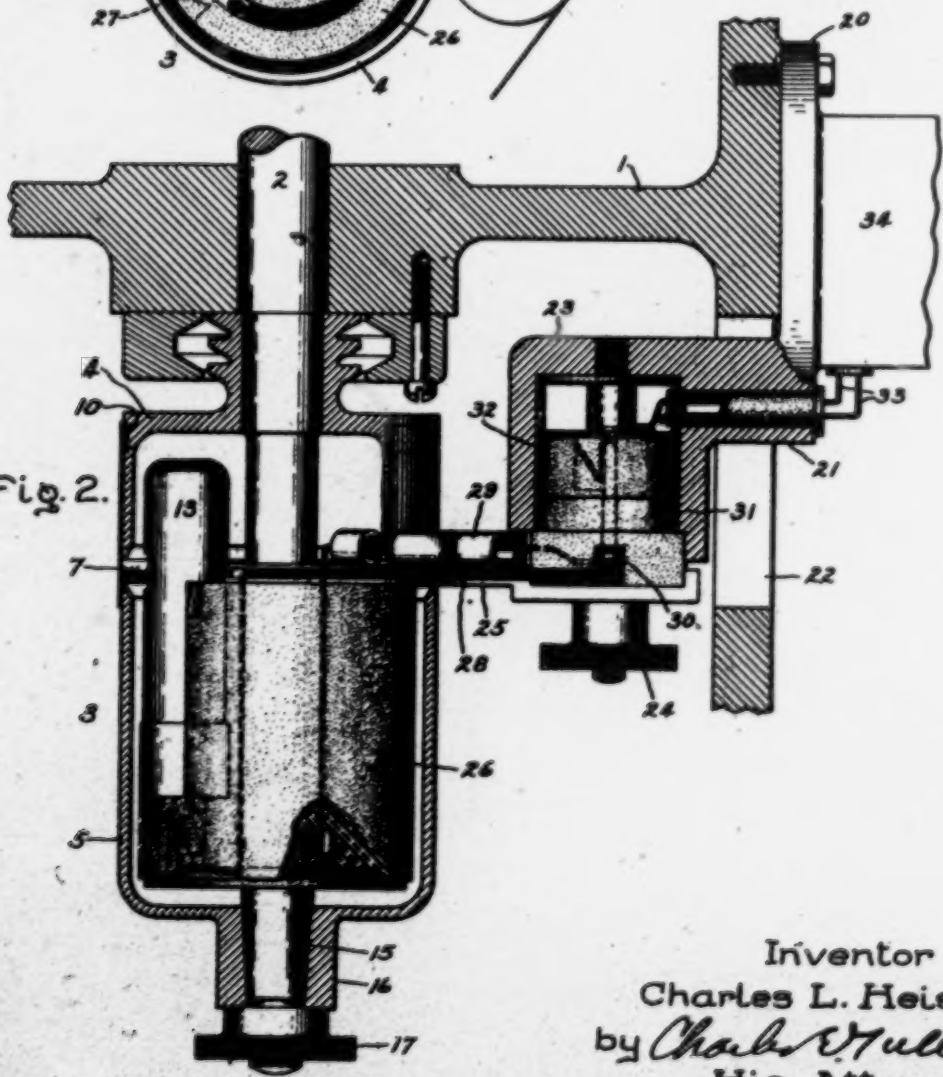


Fig. 2.



Inventor
Charles L. Heisler,
by Charles Mullen
His Attorney.

Dec. 29, 1931. C. L. HEISLER 1,839,151

SOUND REPRODUCING APPARATUS

Filed Sept. 25, 1929 2 Sheets-Sheet 2

Fig. 3.

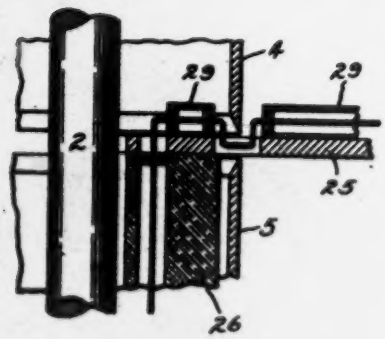


Fig. 4.

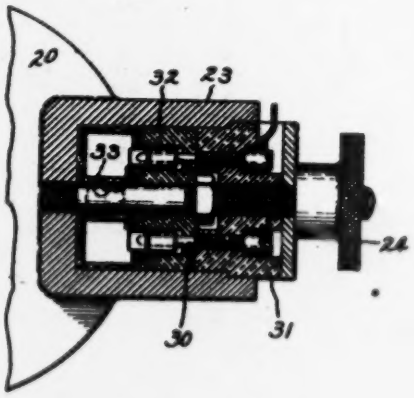
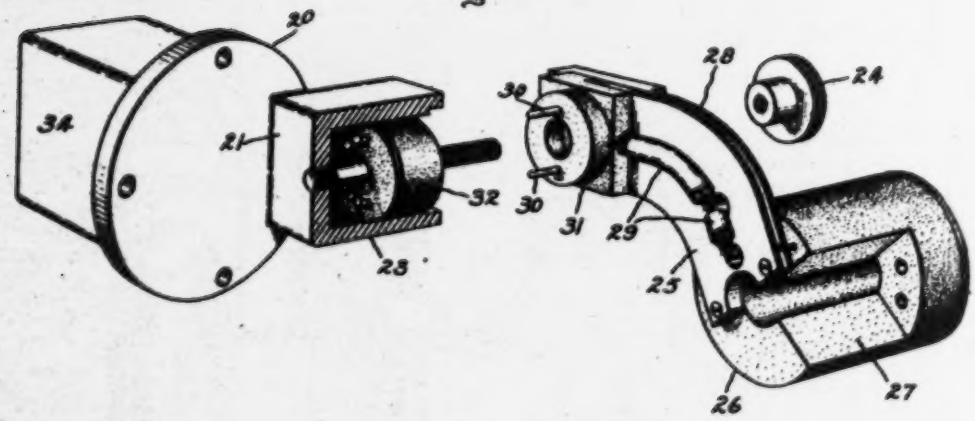


Fig. 5.



Inventor
Charles L. Heisler,
by Charles V. Mills

Patented Dec. 29, 1931

1,839,154

UNITED STATES PATENT OFFICE

CHARLES L. HEISLER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

SOUND REPRODUCING APPARATUS

Application filed September 25, 1929. Serial No. 394,169.

My invention relates to apparatus by which sound may be reproduced electrically from a photographic sound record on a film of the motion picture type, and the object of my invention is the provision of improved supporting means for the film and for the photo-electric member associated therewith.

My invention will be better understood from the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims. This application is a continuation in part of my co-pending application Serial No. 203,344, filed July 5, 1927, now Patent No. 1,771,922, July 29, 1930.

Referring to the drawings, Fig. 1 is a side elevation partly in section of a portion of a reproducing apparatus involving my invention; Fig. 2 is a plan view of the same also partly in section; Figs. 3 and 4 are detail sectional views taken respectively on the lines 3—3 and 4—4 of Fig. 1; and Fig. 5 is a disassembled view of the photo-electric cell supporting means.

In the drawings, the frame 1 of the reproducing machine forms a bearing for the shaft 2 which beyond the bearing carries the film supporting drum 3. The drum, which is preferably constructed of steel, is hollow and is divided circumferentially to form a two-part structure, one part or member 4 being fixed to the shaft and the other part or member 5 being detachably secured to the outer or free end of the shaft. The film 7, of the motion picture type, in its passage from the take-off reel to the take-up reel, both not shown, passes from the guide roller 8 over drum 3 to the pressure roller 9. To insure a more uniform rotation of the drum, the shaft 2 preferably has a fly-wheel mounted thereon. Either the drum may be driven at the desired speed by

The film 7 in the present example has a sound record track extending longitudinally of and adjacent one edge thereof. The space between the two drum portions 4 and 5 is approximately equal to the width of the sound track, being if anything slightly greater than the sound track. In order to increase the adhesion between the drum and the film, the fixed portion 4 of the drum is provided with the rubber tire 10 which is let into the face of the drum so that its periphery is flush with the drum surface. A light beam from a suitable source, not shown, is focused by an optical system shown in part at 12 on the sound record in the form of a very narrow beam which after passing through the record enters the photo-electric cell 13. By this construction the film is firmly supported on both sides of and immediately next to the sound track, thus insuring that the sound record on the film shall remain at all times in the proper focus of the optical system.

Access to the photo-cell 13 is obtained by the removal of the drum portion 5 from the shaft 2. The end portion of the shaft is tapered at 15 and the bore 16 on the drum portion 5 is correspondingly tapered. A thumb nut 17 threaded on the end of shaft 2 clamps the tapered portions together.

The drum not only supports the film in proper focal position at the point of light interception, and by reason of the attached fly-wheel insures a high degree of uniformity of motion thereof, but also shields the photo-cell from various electrical disturbances which otherwise produce objectionable noises in the reproduced sound.

Attached to the frame is the support 20, a portion 24 of which is shown extending through the drum 29 of frame 1 and to

Dec. 29, 1931. C. L. HEISLER 1,839,151

SOUND REPRODUCING APPARATUS

Filed Sept. 25, 1929 2 Sheets-Sheet 2

Fig. 3.

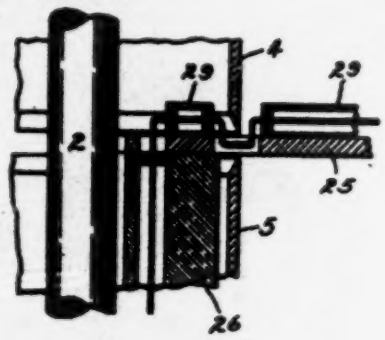


Fig. 4.

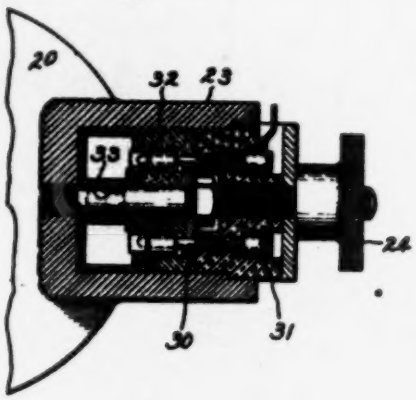
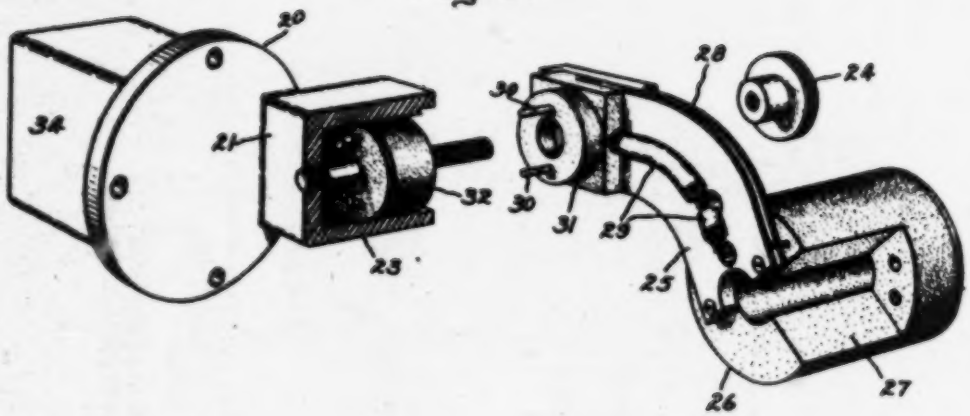


Fig. 5.



Inventor
Charles L. Heisler,
by Charles V. Tulla
His Attorney.

UNITED STATES PATENT OFFICE

CHARLES L. HEISLER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

SOUND REPRODUCING APPARATUS

Application filed September 25, 1929. Serial No. 395,169.

My invention relates to apparatus by which sound may be reproduced electrically from a photographic sound record on a film of the motion picture type, and the object of my invention is the provision of improved supporting means for the film and for the photo-electric member associated therewith.

My invention will be better understood from the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims. This application is a continuation in part of my co-pending application Serial No. 203,344, filed July 5, 1927, now Patent No. 1,771,922, July 29, 1930.

Referring to the drawings, Fig. 1 is a side elevation partly in section of a portion of a reproducing apparatus involving my invention; Fig. 2 is a plan view of the same also partly in section; Figs. 3 and 4 are detail sectional views taken respectively on the lines 3—3 and 4—4 of Fig. 1; and Fig. 5 is a disassembled view of the photo-electric cell supporting means.

In the drawings, the frame 1 of the reproducing machine forms a bearing for the shaft 2 which beyond the bearing carries the film supporting drum 3. The drum, which is preferably constructed of steel, is hollow and is divided circumferentially to form a two-part structure, one part or member 4 being fixed to the shaft and the other part or member 5 being detachably secured to the outer or free end of the shaft. The film 7, of the motion picture type, in its passage from the take-off reel to the take-up reel, both not shown, passes from the guide roller 8 over drum 3 to the pressure roller 9. To insure a more uniform rotation of the drum, the shaft 2 preferably has a fly-wheel mounted thereon. Either the drum may be driven at the desired speed by a connection through the shaft 2 with suitable driving apparatus, such as an electric motor, or the drum and fly-wheel may be driven partly or solely by the pull of the film.

the insulation block 26. This block surrounds the shaft 2 with sufficient clearance to avoid actual contact, and at one side has the recess 27 for receiving the photo-cell 13, suitable socket contacts being provided in the block for engaging the contact posts on the end of the cell. One of the connecting wires is shown embedded in the groove 28 in the bracket 25 and the other is shown enclosed in the steel tube 29 on the side of the bracket. These wires terminate in the plugs 30 in the insulation block 31, and are received by socket contacts in the insulation block 32. From these socket contacts, connecting wires 33 extend into the steel transformer housing 34 from which suitable connection is made to amplifying apparatus and loud speaker or other translating device.

What I claim as new and desire to secure by Letters Patent of the United States is:

tending through the space between the drum portions, an insulation block secured to said bracket within the drum and having a contact socket therein, a photo-electric cell in said socket extending axially between the shaft and the wall of the drum, and circuit connections for said cell secured to said bracket.

In witness whereof, I have hereunto set my hand this 24th day of September, 1929.

CHARLES L. HEISLER.

PLAINTIFFS' EXHIBIT NO. 56.

Copy of File Wrapper and Contents of Taylor Patent No. 1,847,636.

(Physical Exhibit.)

rounds the shaft 7 with sufficient clearance to avoid actual contact, and at one side has the recess 27 for receiving the photo-cell 13, suitable socket contacts being provided in the block for engaging the contact posts on the end of the cell. One of the connecting wires is shown embedded in the groove 28 in the bracket 25 and the other is shown enclosed in the steel tube 29 on the side of the bracket. These wires terminate in the plug 30 in the insulation block 32, and are received by socket contacts in the insulation block 32. From these socket contacts, connecting wires 33 extend into the [illegible] from which suitable connection is made to amplifying apparatus and loud speaker or other translating device.

What I claim as my invention and desire to secure by Letters Patent of the United States is:

[illegible]

4. In apparatus for reproducing [illegible] a film comprising a [illegible] for supporting the film comprising a [illegible] a photo-electric cell [illegible] the shaft and the [illegible] of the drum, [illegible] supporting the cell, a support for the [illegible] for detachably connecting the bracket to the support, a conductor covered by [illegible] and [illegible] extending through the space between the drum portions, an insulation block secured to said bracket within the drum and having a contact socket therein, a photo-electric cell in said socket extending axially between the shaft and the wall of the drum, and circuit connections for said cell secured to said bracket.

In witness whereof, I have hereunto set my hand this 24th day of September, 1929.

CHARLES L. HEISLER.

PLAINTIFFS' EXHIBIT NO. 56.

Copy of File Wrapper and Contents of Taylor Patent No. 1,847,636.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 57.

United States Patent No. 1,891,388.

512

Dec. 20, 1932. J. A. MAURER, JR 1,891,388

RECORDING AND REPRODUCTION OF SOUND

Filed Oct. 28, 1931 2 Sheets-Sheet 1

Fig. 1

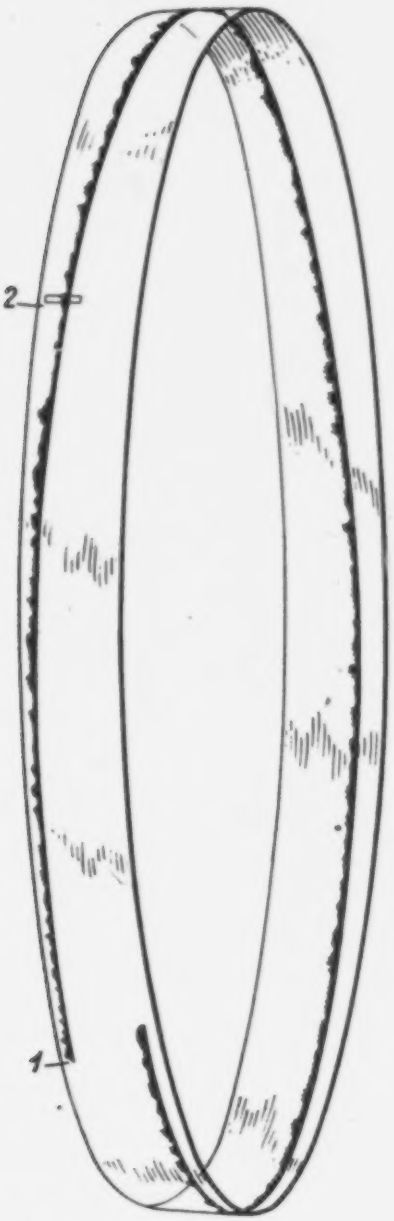
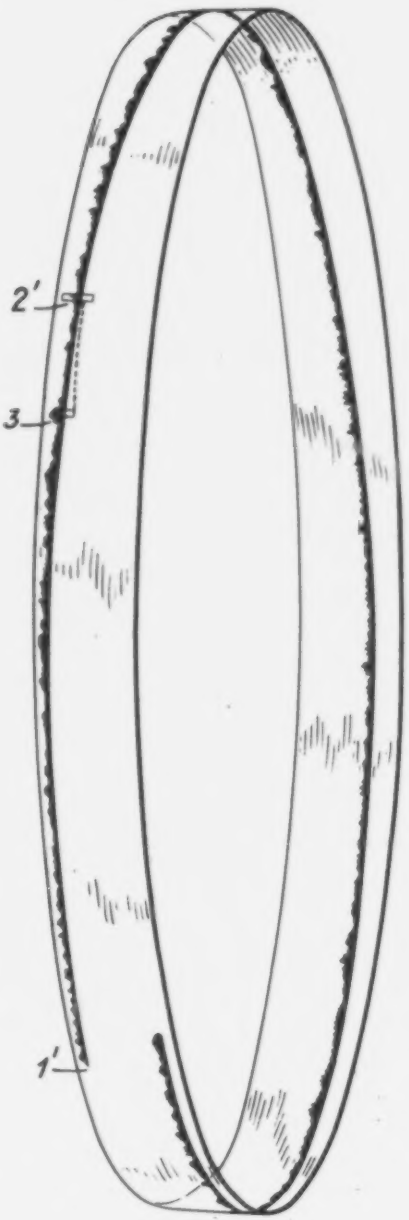


Fig. 2



INVENTOR
JOHN A. MAURER JR.
BY W. G. Grove
ATTORNEY

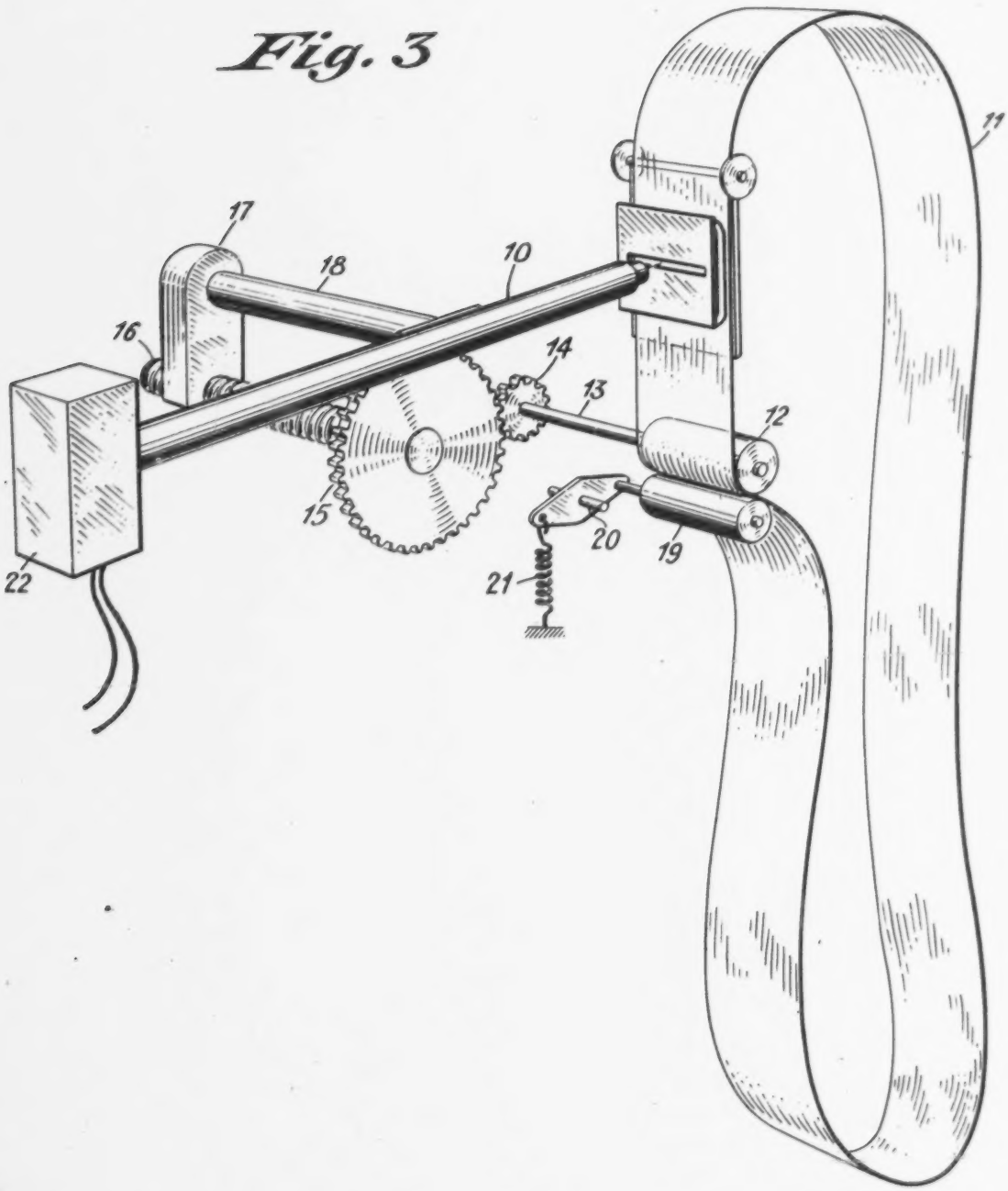
514

Dec. 20, 1932. J. A. MAURER, JR 1,891,388

RECORDING AND REPRODUCTION OF SOUND

Filed Oct. 28, 1931 2 Sheets-Sheet 2

Fig. 3



INVENTOR
JOHN A. MAURER JR.
BY

Patented Dec. 20, 1932

515
1,891,388

UNITED STATES PATENT OFFICE

JOHN A. MAURER, JR., OF NEW YORK, N. Y., ASSIGNOR TO RADIO CORPORATION OF AMERICA, A CORPORATION OF DELAWARE

RECORDING AND REPRODUCTION OF SOUND

Application filed October 28, 1931. Serial No. 571,533.

This invention relates to the recording and reproduction of sound, and has for its principal object the provision of an improved method and apparatus whereby relative movement between a record and a sound recording or sound reproducing element may be very accurately controlled.

In order to facilitate an understanding of the invention it will be described as utilized in the recording of sound on a photographic film along a helical path or track, and in the reproduction of sound from such a record. Specifically the application is to the type of record hereinafter referred to as microphotographic, that is, a record wherein the sound track is of the order of a few thousandths of an inch wide. In one successfully operated embodiment of the invention the width of the helical sound track is two thousandths of an inch and the spacing from center to center of adjacent tracks is four thousandths. It should be understood that these specific dimensions are given only for purposes of illustration, and that the invention is in no wise limited to them.

In reproducing sound from such a record a beam of light in the form of a rectangle of length nearly equal to the width of the sound track is made to pass through the film while the latter is moved at a constant speed. It will be readily apparent that if this light beam is not at all times accurately registered upon the track the sound reproduction will be distorted.

This invention is in some respects an improvement on the invention disclosed by a Patent 1,776,123, granted to J. C. Kroesen on September 16, 1930. This patent discloses in Fig. 1 a helical type sound record provided with sprocket holes; in Figs. 2 and 3 a sound reproducer wherein the light source and photo cell are moved transversely of a sprocket driven film, and in Fig. 4 a sound reproducer wherein the sprocket driven film is moved relatively to light source and photo cell, in each case in such a way that the light beam follows the displacement of the helical track across the width of the film.

from such a record by the sprocket drive mechanism disclosed in the aforesaid patent, however, is not altogether satisfactory from a practical viewpoint for the reason that the registry of the light beam on the sound track is likely to be disturbed by shrinkage of the film.

Thus in using the mechanism disclosed in the Kroesen patent the film loop is driven by the sprocket a constant number of revolutions per unit time or a constant number of sprocket holes per unit time, while at the same time the gear train and lead screw advance the light source and photo cell a definite distance. If this distance is chosen to be correct for unshrunken film there will be a variable amount of inaccuracy in the registration on shrunken films. Since in practice shrinkage of the developed record may amount to any value up to about one and one-half percent, it is not possible to compensate for it by a particular choice of the rate of feed of the lead screw. Shrinkage of negative stock is of the order of one-tenth to one-fourth of one percent and likewise varies in different cases.

This lack of registration due to film shrinkage becomes more serious as the sound track is made narrower, and in the case of a track of the microscopic dimensions referred to above it may amount to several times the width of the track.

It is possible to introduce compensating means whereby the rate of advance of the light beam is varied to correspond with the shrinkage of the film, thereby maintaining correct registry with sprocket drive of the film. Such means are to form the subject matter of a subsequent application.

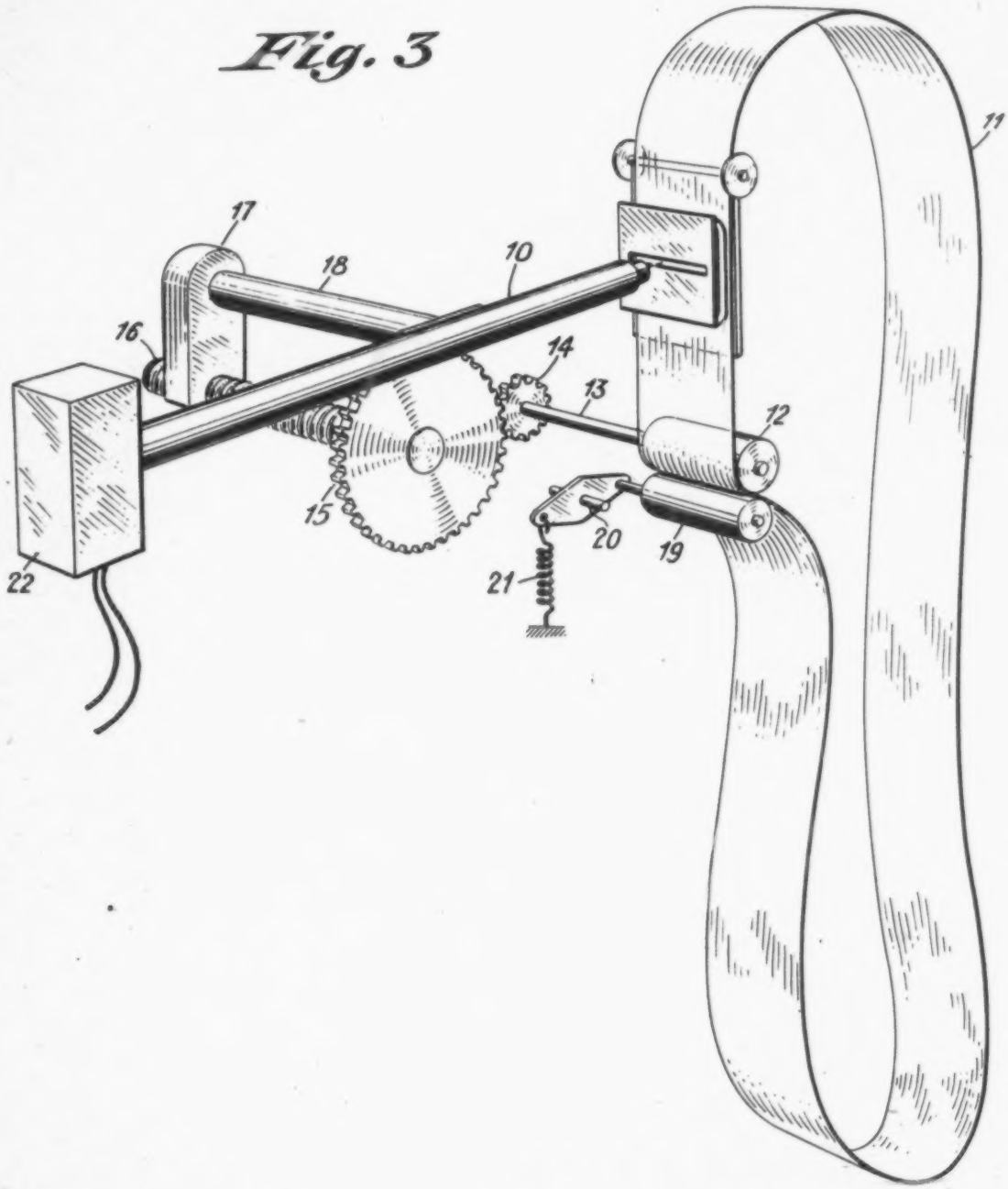
In accordance with the present invention, however, this lack of registry between the beam and track is obviated by driving the film through frictional contact. Thus if the record is made with a constant lateral displacement of the helical track and is driven by close frictional engagement with a wheel or drum driven at uniform speed, it will be

Dec. 20, 1932. J. A. MAURER, JR 1,891,388

RECORDING AND REPRODUCTION OF SOUND

Filed Oct. 28, 1931 2 Sheets-Sheet 2

Fig. 3



INVENTOR
JOHN A. MAURER JR.
BY
ATTORNEY

UNITED STATES PATENT OFFICE

JOHN A. MAURER, JR., OF NEW YORK, N. Y., ASSIGNOR TO RADIO CORPORATION OF AMERICA, A CORPORATION OF DELAWARE

RECORDING AND REPRODUCTION OF SOUND

Application filed October 26, 1931. Serial No. 571,533.

This invention relates to the recording and reproduction of sound, and has for its principal object the provision of an improved method and apparatus whereby relative movement between a record and a sound recording or sound reproducing element may be very accurately controlled.

In order to facilitate an understanding of the invention it will be described as utilized in the recording of sound on a photographic film along a helical path or track, and in the reproduction of sound from such a record. Specifically the application is to the type of record hereinafter referred to as microphotographic, that is, a record wherein the sound track is of the order of a few thousandths of an inch wide. In one successfully operated embodiment of the invention the width of the helical sound track is two thousandths of an inch and the spacing from center to center of adjacent tracks is four thousandths. It should be understood that these specific dimensions are given only for purposes of illustration, and that the invention is in no wise limited to them.

In reproducing sound from such a record a beam of light in the form of a rectangle of length nearly equal to the width of the sound track is made to pass through the film while the latter is moved at a constant speed. It will be readily apparent that if this light beam is not at all times accurately registered upon the track the sound reproduction will be distorted.

This invention is in some respects an improvement on the invention disclosed by a Patent 1,776,123, granted to J. C. Kroesen on September 16, 1930. This patent discloses in Fig. 1 a helical type sound record provided with sprocket holes; in Figs. 2 and 3 a sound reproducer wherein the light source and photo cell are moved transversely of a sprocket driven film, and in Fig. 4 a sound reproducer wherein the sprocket driven film is moved relatively to light source and photo cell, in each case in such a way that the light beam follows the displacement of the helical track across the width of the film.

The recording of sound in the form of a helical record and the reproduction of sound from such a record by the sprocket drive mechanism disclosed in the aforesaid patent, however, is not altogether satisfactory from a practical viewpoint for the reason that the registry of the light beam on the sound track is likely to be disturbed by shrinkage of the film.

Thus in using the mechanism disclosed in the Kroesen patent the film loop is driven by the sprocket a constant number of revolutions per unit time or a constant number of sprocket holes per unit time, while at the same time the gear train and lead screw advance the light source and photo cell a definite distance. If this distance is chosen to be correct for unshrunken film there will be a variable amount of inaccuracy in the registration on shrunken films. Since in practice shrinkage of the developed record may amount to any value up to about one and one-half percent, it is not possible to compensate for it by a particular choice of the rate of feed of the lead screw. Shrinkage of negative stock is of the order of one-tenth to one-fourth of one percent and likewise varies in different cases.

This lack of registration due to film shrinkage becomes more serious as the sound track is made narrower, and in the case of a track of the microscopic dimensions referred to above it may amount to several times the width of the track.

It is possible to introduce compensating means whereby the rate of advance of the light beam is varied to correspond with the shrinkage of the film, thereby maintaining correct registry with sprocket drive of the film. Such means are to form the subject matter of a subsequent application.

In accordance with the present invention, however, this lack of registry between the beam and track is obviated by driving the film through frictional contact. Thus if the record is made with a constant lateral displacement of the helical track and is driven by close frictional engagement with a wheel or drum driven at uniform speed, it will be moved a constant number of feet per unit time. Under these conditions, the displacement of the record per unit length of the

film will be the same on the shrunken film as on the unshrunken film and the light beam will follow the record accurately regardless of shrinkage. The only result of shrinkage will be that the pitch of the reproduced sound is raised slightly. This rise in pitch has been unobjectionable from a practical viewpoint.

Since the film must be guided laterally by its edge, there will be a slight displacement of the initial record turn relative to the light beam due to shrinkage. This error however results only from shrinkage in the relatively narrow marginal area and may be corrected by making the starting point of the beams correspond to a partly shrunken film and allowing the beam to overlap the sound track, thus permitting slight variation in shrinkage without seriously disturbing the registry between the beam and track. In the practical use of the apparatus, it has been found satisfactory to place the shrunken film on its support and adjust the position of the light beam so that it registers with the first turn of the track.

The invention will be better understood from the following description when considered in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

Referring to the drawings:

Figure 1 illustrates an unshrunken loop of film bearing a helical sound record,

Figure 2 illustrates the same loop of film after shrinkage has taken place, and

Figure 3 illustrates a form of frictional drive mechanism whereby this record may be recorded and reproduced.

In Figures 1 and 2 only one turn of the helix is shown for the sake of clearness and the shrinkage is shown greatly exaggerated. In practice the helix may consist of as many as three hundred turns, and the shrinkage may be of the order of one percent.

In the recording of the sound track shown in Figure 1 the light beam starts at 1 and advances laterally at the same time that the loop is moved lengthwise, so that at the end of a certain time the light has reached the position shown at 2. In reproducing from the same record if unshrunken the same action would take place. Shrinkage always takes place in processing, however, so that this condition does not exist in practice.

Now referring to Figure 2, if the film is driven by friction, in accordance with the present invention, at the end of the time referred to above the film will have been moved the same distance as before and the light beam which was first registered at 1 will be shrunken film, and if the light beam has been advanced at the same rate as before it will be in register with the track as shown at 2'.

But if the film is driven by a sprocket it will have travelled a shorter distance in this period of time, because the pitch of the sprocket holes has been shortened, and the light beam will be at 3. Having been advanced too fast it will be out of register with the track, as shown. As is shown in the drawings, in the case of the sprocket drive the light beam will have scanned in any interval of time the same portion of the sound track which was recorded in the same interval of time, that is, the sounds are reproduced at their original pitch. They eventually become distorted, however, because of the inaccurate registry of the light beam.

When the film is driven by friction the light beam scans a greater portion of the sound record than was recorded in the same length of time, that is, the pitch of the sounds is slightly raised due to shrinkage of the film. In practice this rise does not exceed one and one-half percent, and is entirely unobjectionable.

Figure 3 illustrates an apparatus wherein a light beam is moved by an optical system 10 across a record strip 11. It will be noted that the film 11 is driven by friction between it and a roller 12 mounted on a drive shaft 13; that the optical system 10 is coupled to the drive shaft 13 through gears 14 and 15, a lead screw 16 and a nut 17 which is connected to the optical system 10 through a support member 18 and is arranged to cooperate with the lead screw 16; and that a roller 19 pivoted at the point 20 and biased into contact with the film 11 by a spring 21 may be provided for ensuring proper contact between the film and the frictional drive roller 12.

It will be readily understood that the invention is useful in both the recording and reproduction of records, the illustrated apparatus being merely illustrative of one of its many possible forms. Thus if the apparatus is to be utilized as a recorder, the casing 22 at the left hand end may contain any suitable light modulating means such as a glow tube or light valve. If the apparatus is to be utilized as a producer, this casing may contain an exciter lamp of any suitable type. Also various modifications may obviously be made in the other features of the apparatus without departing from the spirit and scope of the invention which relates primarily to record driving means whereby the inaccuracies heretofore resulting from film

28, 1931, and its application to a sound reproducer is covered in a copending application, Serial No. 571,534, filed October 28, 1931, both these applications being assigned to the same assignee as the present application.

Having thus described my invention, what I claim is:

1. In an apparatus for producing relative movement between a record strip and a light beam, the combination of frictional drive means for moving said strip at a substantially uniform linear speed, and means for moving said beam across said strip at a rate of speed proportional to said linear speed.

2. The method of producing relative movement between a record strip and a light beam which includes frictionally moving said strip at a substantially uniform linear speed, and moving said beam across said strip at a rate of speed proportional to said linear speed.

3. In an apparatus for producing relative movement between a continuous loop record and a light beam, the combination of frictional drive means for moving said loop at a substantially uniform linear speed, and means for moving said beam across said loop at a rate of speed proportional to said linear speed.

4. In an apparatus for producing relative movement between a record strip and a light beam, the combination of drive means for moving said beam across said film at a substantially uniform linear speed, and means operable in response to said drive means to move said film through frictional engagement at a rate of speed proportional to said linear speed.

5. The method of producing relative movement between a record strip and a light beam which includes moving said beam at a substantially uniform linear speed, and moving said strip at a rate of speed which does not vary with respect to said linear speed irrespective of change in the dimensions of said strip.

6. The method of producing relative movement between a continuous loop record and a light beam which includes moving said beam at a substantially uniform linear speed and moving said loop at a rate of speed which does not vary with respect to said linear speed irrespective of change in the dimensions of said record.

7. In an apparatus for producing relative movement between a strip bearing a record and a light beam, the combination of means for moving said strip longitudinally, and means for moving said beam transversely of said strip at a speed proportional to the width of said record irrespective of shrinkage of said strip.

9. In an apparatus for producing relative movement between a continuous loop record and a light beam, the combination of means for moving said loop longitudinally, and means for moving said beam across said loop at a rate of speed proportional to the loop length irrespective of change in the dimensions of said loop.

JOHN A. MAURER, Jr.

film will be the same on the shrunken film as on the unshrunken film and the light beam will follow the record accurately regardless of shrinkage. The only result of shrinkage will be that the pitch of the reproduced sound is raised slightly. This rise in pitch has been unobjectionable from a practical viewpoint.

Since the film must be guided laterally by its edge, there will be a slight displacement of the initial record turn relative to the light beam due to shrinkage. This error however results only from shrinkage in the relatively narrow marginal area and may be corrected by making the starting point of the beams correspond to a partly shrunken film and allowing the beam to overlap the sound track, thus permitting slight variation in shrinkage without seriously disturbing the registry between the beam and track. In the practical use of the apparatus, it has been found satisfactory to place the shrunken film on its support and adjust the position of the light beam so that it registers with the first turn of the track.

The invention will be better understood from the following description when considered in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

Referring to the drawings:

Figure 1 illustrates an unshrunken loop of film bearing a helical sound record,

Figure 2 illustrates the same loop of film after shrinkage has taken place, and

Figure 3 illustrates a form of frictional drive mechanism whereby this record may be recorded and reproduced.

In Figures 1 and 2 only one turn of the helix is shown for the sake of clearness and the shrinkage is shown greatly exaggerated. In practice the helix may consist of as many as three hundred turns, and the shrinkage may be of the order of one percent.

In the recording of the sound track shown in Figure 1 the light beam starts at 1 and advances laterally at the same time that the loop is moved lengthwise, so that at the end of a certain time the light has reached the position shown at 2. In reproducing from the same record if unshrunken the same action would take place. Shrinkage always takes place in processing, however, so that this condition does not exist in practice.

Now referring to Figure 2, if the film is driven by friction, in accordance with the present invention, at the end of the time referred to above the film will have been moved the same distance as before and the light beam which was first registered at 1′ will be passing through the point 2′. Since the shrinkage of the film is the same laterally as longitudinally (a fact which has been established by experience) the rate of lateral displacement of the track is the same on the shrunken film, and if the light beam has been advanced at the same rate as before it will be in register with the track as shown at 2′.

But if the film is driven by a sprocket it will have travelled a shorter distance in this period of time, because the pitch of the sprocket holes has been shortened, and the light beam will be at 3. Having been advanced too fast it will be out of register with the track, as shown. As is shown in the drawings, in the case of the sprocket drive the light beam will have scanned in any interval of time the same portion of the sound track which was recorded in the same interval of time, that is, the sounds are reproduced at their original pitch. They eventually become distorted, however, because of the inaccurate registry of the light beam.

When the film is driven by friction the light beam scans a greater portion of the sound record than was recorded in the same length of time, that is, the pitch of the sounds is slightly raised due to shrinkage of the film. In practice this rise does not exceed one and one-half percent, and is entirely unobjectionable.

Figure 3 illustrates an apparatus wherein a light beam is moved by an optical system 10 across a record strip 11. It will be noted that the film 11 is driven by friction between it and a roller 12 mounted on a drive shaft 13; that the optical system 10 is coupled to the drive shaft 13 through gears 14 and 15, a lead screw 16 and a nut 17 which is connected to the optical system 10 through a support member 18 and is arranged to cooperate with the lead screw 16; and that a roller 19 pivoted at the point 20 and biased into contact with the film 11 by a spring 21 may be provided for ensuring proper contact between the film and the frictional drive roller 12.

It will be readily understood that the invention is useful in both the recording and reproduction of records, the illustrated apparatus being merely illustrative of one of its many possible forms. Thus if the apparatus is to be utilized as a recorder, the casing 22 at the left hand end may contain any suitable light modulating means such as a glow tube or light valve. If the apparatus is to be utilized as a producer, this casing may contain an exciter lamp of any suitable type. Also various modifications may obviously be made in the other features of the apparatus without departing from the spirit and scope of the invention which relates primarily to record driving means whereby the inaccuracies heretofore resulting from film shrinkage are obviated.

The invention disclosed herein is believed to be generic and not limited to any specific use of the apparatus. Its specific application to a sound recorder is covered in a copending application Serial No 571,532, filed October

Serial No. 571,534, filed October 28, 1931, both these applications being assigned to the same assignee as the present application.

Having thus described my invention, what I claim is:

1. In an apparatus for producing relative movement between a record strip and a light beam, the combination of frictional drive means for moving said strip at a substantially uniform linear speed, and means for moving said beam across said strip at a rate of speed proportional to said linear speed.

2. The method of producing relative movement between a record strip and a light beam which includes frictionally moving said strip at a substantially uniform linear speed, and moving said beam across said strip at a rate of speed proportional to said linear speed.

3. In an apparatus for producing relative movement between a continuous loop record and a light beam, the combination of frictional drive means for moving said loop at a substantially uniform linear speed, and means for moving said beam across said loop at a rate of speed proportional to said linear speed.

4. In an apparatus for producing relative movement between a record strip and a light beam, the combination of drive means for moving said beam across said film at a substantially uniform linear speed, and means operable in response to said drive means to move said film through frictional engagement at a rate of speed proportional to said linear speed.

5. The method of producing relative movement between a record strip and a light beam which includes moving said beam at a substantially uniform linear speed, and moving said strip at a rate of speed which does not vary with respect to said linear speed irrespective of change in the dimensions of said strip.

6. The method of producing relative movement between a continuous loop record and a light beam which includes moving said beam at a substantially uniform linear speed and moving said loop at a rate of speed which does not vary with respect to said linear speed irrespective of change in the dimensions of said record.

7. In an apparatus for producing relative movement between a strip bearing a record and a light beam, the combination of means for moving said strip longitudinally, and means for moving said beam transversely of said strip at a speed proportional to the width of said record irrespective of shrinkage of said strip.

8. In an apparatus for producing relative movement between a light beam and a strip bearing sound record, the combination of means for moving said strip longitudinally, width of said record irrespective of shrinkage of said strip.

9. In an apparatus for producing relative movement between a continuous loop record and a light beam, the combination of means for moving said loop longitudinally, and means for moving said beam across said loop at a rate of speed proportional to the loop length irrespective of change in the dimensions of said loop.

JOHN A. MAURER, Jr.

PLAINTIFFS' EXHIBIT NO. 58.

Copy of File Wrapper and Contents of Page Patent No. 1,892,218.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 59.

United States Patent No. 1,892,554.

522

Dec. 27, 1932. E. W. KELLOGG 1,892,554

FILM SUPPORTING AND DRIVING APPARATUS

Filed July 27, 1928

Fig. 1.

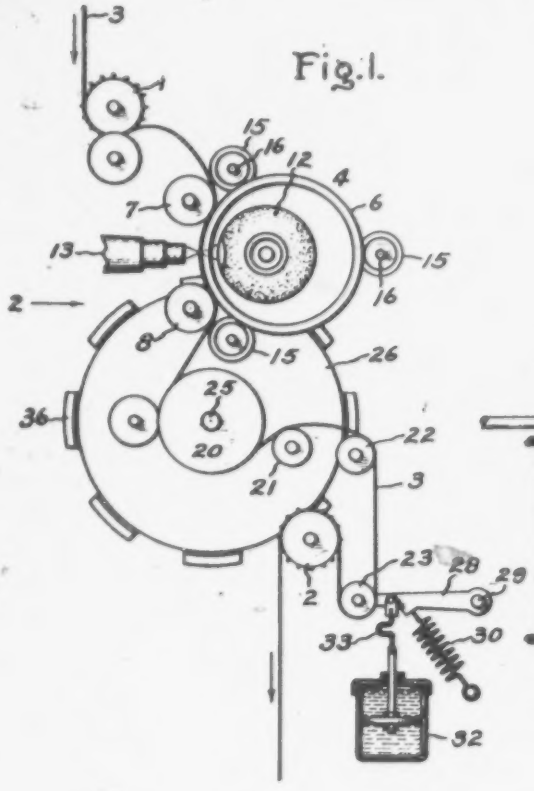


Fig. 2.

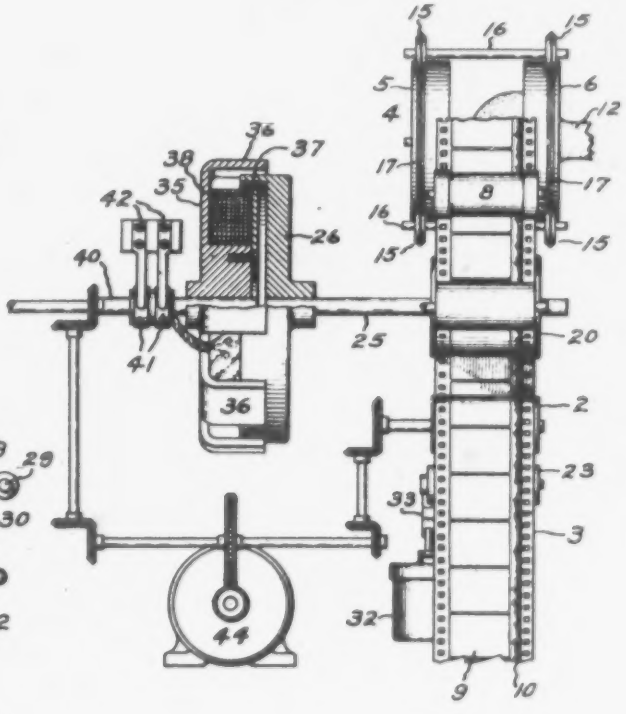
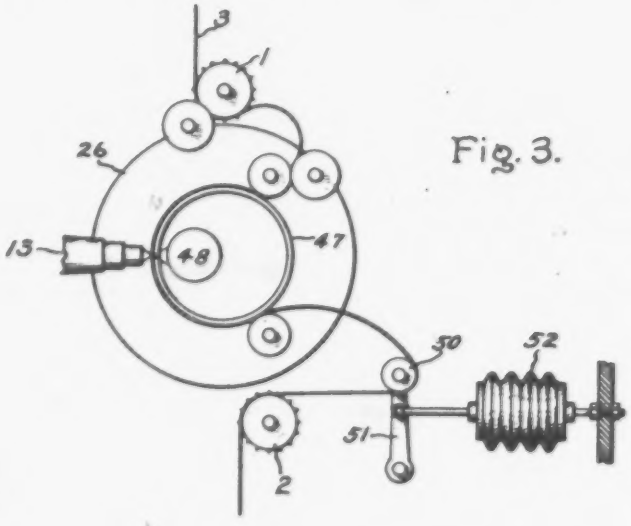


Fig. 3.



Inventor
Edward W. Kellogg,
by Charles F. Mullen

Patented Dec. 27, 1932

1,892,554

UNITED STATES PATENT OFFICE

EDWARD W. KELLOGG, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

FILM SUPPORTING AND DRIVING APPARATUS

Application filed July 27, 1928. Serial No. 295,780.

My invention relates to film supporting and driving apparatus particularly for the purpose of recording sound photographically on a film and for reproducing sound from a film record. An object of my invention is the provision of apparatus of this character having improved means for supporting the moving film and improved means for moving the film at a substantially uniform speed.

In the past the means for supporting the film at the point where the light is projected on it have been either of the nature of gates or skids in which the film slips over the supporting surface, or of rotating drums. The skids or sliding devices often cut the surface of the film owing to the lodgment of particles of dirt or abrasive matter. A drum is very satisfactory for purposes of making records, but in reproduction, in which the light after passing through the film enters a photo-electric cell, it is obvious that the supporting surface must either be of transparent material or else cut away opposite the sound record part of the film in order to let the light through. The objection to the use of transparent material is that if dirt collects on the surface, it causes an irregular obstruction of part of the light and thereby produces objectionable noise when the recorded sound is reproduced. If an opaque drum is used with part of its cylindrical surface cut away the problem is to provide support for both parts of the drum surface, and at the same time leave room for the photo-cell and its support. In general the cell must be small enough to go entirely inside the drum which is made more difficult by the presence of the shaft within the drum, and be supported through the slot. My present invention provides a supporting means for the film which has the merits of the drum in that there is a rolling rather than a sliding contact with the film and it permits the photo-cell to be placed in the path of the light beam without the difficulty, crowding and awkward sup-

gears or belts or both from a motor, is not sufficiently steady for satisfactory reproduction of music even though the motor speed be constant. Imperfections in gears and joints in belts cause changes in sprocket speed. It is difficult to obtain a sprocket which is sufficiently free from inaccuracies, and finally even a perfectly formed sprocket running at constant speed would not produce uniform film motion unless the pitch of the film perforations is exactly equal to the sprocket tooth pitch, a condition which is rarely met owing to the varying shrinkage of films. As a means of improving the steadiness of film motion, use has been made of a smooth, cylindrical drum on the shaft of which is a flywheel, the film being held against the drum by one or more pressure rollers. The film is pulled by the sprocket and the tension on that part of the film between the drum and the sprocket causes the drum and flywheel to rotate. This arrangement is helpful but a practical difficulty arises. If a very light flywheel is used, the drum runs easily but the flywheel effect is inadequate. As the size of the flywheel is increased the bearing friction becomes greater and the film tension is increased. The tighter the film, the more forcibly it transmits jerks from the sprocket to the drum and the result is that even the large flywheel undergoes objectionable accelerations, or else the film slips on the drum, either of which defeats the purpose sought.

One method which has been employed to reduce the violence of jerks on the film is to pass the film over a spring-supported roller arranged between the drum and the sprocket. While such an arrangement is advantageous in increasing the flexibility, I have found that under certain conditions another difficulty is encountered, namely that known as "hunting". In accordance with my invention I have provided film driving apparatus including means for increasing [illegible]

FILM SUPPORTING AND DRIVING APPARATUS

Filed July 27, 1928

Fig. 1.

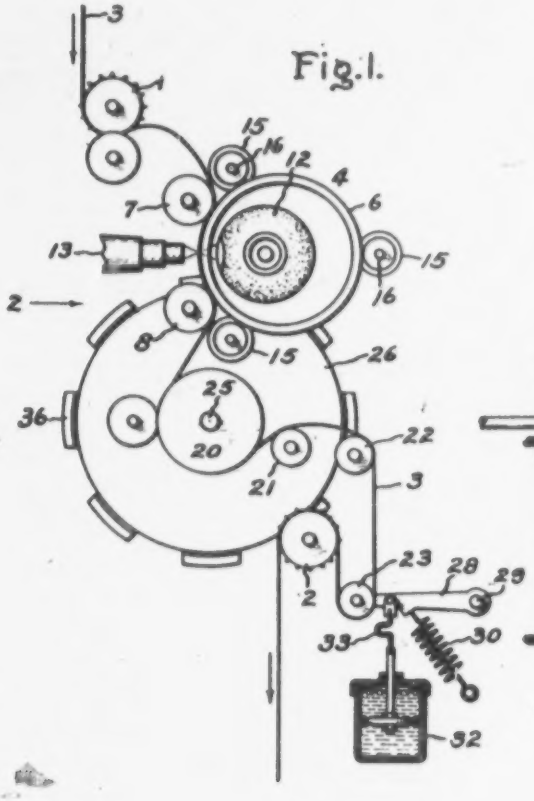


Fig. 2.

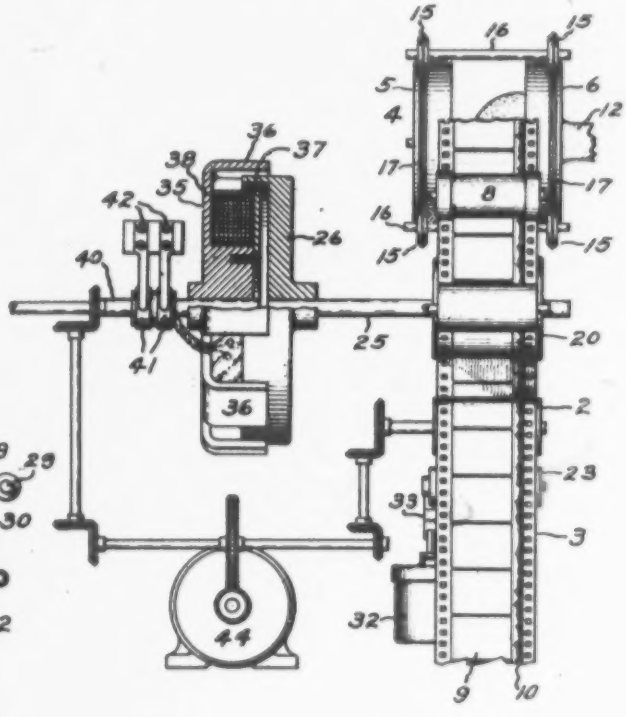
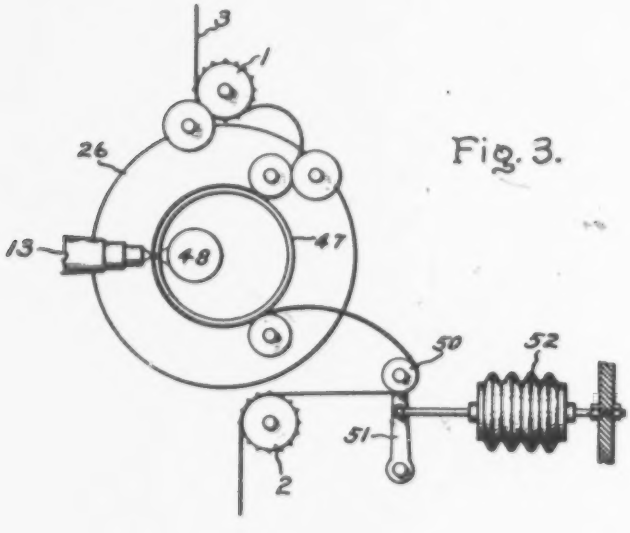


Fig. 3.



Inventor
Edward W. Kellogg,
by Charles F. Mullen
His Attorney.

UNITED STATES PATENT OFFICE

EDWARD W. KELLOGG, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

FILM SUPPORTING AND DRIVING APPARATUS

Application filed July 27, 1923. Serial No. 295,780.

My invention relates to film supporting and driving apparatus particularly for the purpose of recording sound photographically on a film and for reproducing sound from a film record. An object of my invention is the provision of apparatus of this character having improved means for supporting the moving film and improved means for moving the film at a substantially uniform speed.

In the past the means for supporting the film at the point where the light is projected on it have been either of the nature of gates or skids in which the film slips over the supporting surface, or of rotating drums. The skids or sliding devices often cut the surface of the film owing to the lodgment of particles of dirt or abrasive matter. A drum is very satisfactory for purposes of making records, but in reproduction, in which the light after passing through the film enters a photo-electric cell, it is obvious that the supporting surface must either be of transparent material or else cut away opposite the sound record part of the film in order to let the light through. The objection to the use of transparent material is that if dirt collects on the surface, it causes an irregular obstruction of part of the light and thereby produces objectionable noise when the recorded sound is reproduced. If an opaque drum is used with part of its cylindrical surface cut away the problem is to provide support for both parts of the drum surface, and at the same time leave room for the photo-cell and its support. In general the cell must be small enough to go entirely inside the drum which is made more difficult by the presence of the shaft within the drum, and be supported through the slot. My present invention provides a supporting means for the film which has the merits of the drum in that there is a rolling rather than a sliding contact with the film and it permits the photo-cell to be placed in the path of the light beam without the difficulty, crowding and awkward support involved in the case of the drum.

My invention also is concerned with the production of uniform motion of the film. The movement of film produced by a sprocket, the sprocket being driven through gears or belts or both from a motor, is not sufficiently steady for satisfactory reproduction of music even though the motor speed be constant. Imperfections in gears and joints in belts cause changes in sprocket speed. It is difficult to obtain a sprocket which is sufficiently free from inaccuracies, and finally even a perfectly formed sprocket running at constant speed would not produce uniform film motion unless the pitch of the film perforations is exactly equal to the sprocket tooth pitch, a condition which is rarely met owing to the varying shrinkage of films. As a means of improving the steadiness of film motion, use has been made of a smooth, cylindrical drum on the shaft of which is a flywheel, the film being held against the drum by one or more pressure rollers. The film is pulled by the sprocket and the tension on that part of the film between the drum and the sprocket causes the drum and flywheel to rotate. This arrangement is helpful but a practical difficulty arises. If a very light flywheel is used, the drum runs easily but the flywheel effect is inadequate. As the size of the flywheel is increased the bearing friction becomes greater and the film tension is increased. The tighter the film, the more forcibly it transmits jerks from the sprocket to the drum and the result is that even the large flywheel undergoes objectionable accelerations, or else the film slips on the drum, either of which defeats the purpose sought.

One method which has been employed to reduce the violence of jerks on the film is to pass the film over a spring-supported roller arranged between the drum and the sprocket. While such an arrangement is advantageous in increasing the flexibility, I have found that under certain conditions another difficulty is encountered, namely that known as "hunting". In accordance with my invention I have provided film driving apparatus including means for increasing flexibility together with means for preventing hunting of the apparatus by the use of damping or energy absorbing means. As an additional means of insuring flexibility I also provide an auxiliary driving means to reduce the

tension on the film, which means supplies a part of the torque required to maintain the rotation of the drum.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Figs. 1 and 2 are diagrammatic views taken at right angles to each other illustrating a preferred embodiment of my invention and Fig. 3 is a view similar to Fig. 1 showing a modification.

The apparatus comprising my invention is applicable for use either in the recording of sound on a sensitive film or in the reproducing of sound from a film record. I have chosen to illustrate it, however, as applied to a reproducer.

The main film driving elements of the apparatus are the sprockets 1 and 2, the former drawing the film 3 from a reel or from a picture projector, not shown, as the case may be and feeding it to the supporting means 4. This means comprises the two rings 5 and 6 against which the film is pressed by the rollers 7 and 8 which preferably are rubber faced. The film 3 as shown in Fig. 2 has thereon a picture record 9 and a sound record 10 arranged side by side between the two marginal rows of sprocket holes. While I have shown the rings 5 and 6 spaced apart a distance approximately equal to the combined width of the picture and sound records it is to be understood that they need be spaced only the width of the sound record. Within the rings, or in the present example within ring 6, is the photo-electric cell 12 and opposite the curved portion of the film supported on the rings is the optical system 13 by means of which a very narrow light beam of the order of one mil in width is directed on that part of the film bearing the sound record. This light as modified by the sound record passes on into the cell 12 from which current variations are received corresponding to the sound record. Rings 5 and 6 are mounted for free co-axial rotation by means of the rollers 15 of which I have shown by way of example three arranged at angles of 120 degrees around each ring. I have also shown the corresponding rollers of each ring mounted on a common shaft 16. If desired, a greater number of rollers may be employed and also they may have separate mountings. As an alternative construction the rings may be carried on ball races if desired. As a means of maintaining the rings in proper alinement I have formed each with a V-shaped groove 17 into which fit the correspondingly shaped faces of the rollers. The film is thereby supported at each side of the

From the supporting rings the film passes successively over the drum 20, fixed rollers 21 and 22, movable idler 23 and sprocket 2 to the receiving reel, not shown, or to other apparatus. Drum 20 is freely rotatable and is shown mounted on the shaft 25 on which also is mounted the disk 26 comprising a flywheel, the mass of which tends to maintain the speed of the film constant. Were the film to be carired directly from the drum to the sprocket 2, a jerk at the sprocket would be transmitted forcibly to the film on the drum either causing the film to slip over the drum or to accelerate the drum and flywheel and an irregularity in speed would thus be communicated to the point of application of the light beam. Accordingly I provide between the sprocket 2 and the drum 20 the idler 23 mounted on the arm 28 pivoted at 29. This idler engages a loop in the film which is given more or less tension by the spring 30 connected to the arm 28. A jerk or momentary speed change at the sprocket now results only in a slight movement of the idler 23 and a very small change in the tension on the film, and the speed of the drum is practically unaffected, nor is there any tendency for the film to slip on the drum. The idler 23 assumes a mean position at which the tension produced by the spring is just sufficient to overcome the frictional resistance of the drum, rings, and rollers. I have found that the arrangement, as so far described, while tending in the main to reduce speed fluctuations, is under certain conditions subject to hunting. For example, suppose that for the moment the drum with its flywheel is running too slowly, the loop engaged by the idler 23 shortens and the tension of the spring 30 is increased. The drum in response to the greater film tension is accelerated and the idler returns to its original position but the drum has acquired a speed greater than normal and accordingly the idler passes beyond its normal position down to a new position where the tension of the spring is below normal. Now the film tension, being below normal, allows the drum to lose speed and again we have the condition with which we started. This process may continue through many cycles, or even indefinitely, especially if any speed variations at the sprocket coincide in frequency of repetition with the frequency at which the system tends to hunt, and while bearing and other friction tends in a slight degree to damp out such oscillations of speed it is entirely inadequate where constant speed is required. It is also true of the system in which the flexibly supported roller 23 is omitted that hunting occurs. The elastic stretch of the film as the tension varies constitutes the elastic element of the oscillatory

bility, greatly lengthens the period of the hunting and also makes it more evident to the eye since changes of tension are marked by changes in the position of the roller or length of loop. To prevent hunting in apparatus such as I have described, I have provided means for damping out the recurring speed variations. One of these means is the dash pot 32 of the well known liquid type, the movable member of which connects with the arm 28. To permit sudden quick movements of the idler 23, I employ a yielding member such as the spring 33 in the connection between the dash pot and the arm 28. This spring is stiff compared with spring 30 and does not appreciably reduce the effectiveness of the dash pot in preventing hunting.

I have provided an additional arrangement for supplementing the flexibility introduced by the above described movable idler, which comprises carrying the film over the adjacent successive rollers 21 and 22 in the same direction forming a free span therebetween. The natural stiffness of the film causes it to bow up slightly as so arranged, the amount of excess length being decidedly greater than that resulting from the curvature which a film takes when passed in opposite directions over two successive rollers. The bowing up of the film is most noticeable if the rollers are of small diameter. The slight excess length thus introduced in the film is insurance against the transmission of very short and rapid jerks such as may result from tooth action of the sprocket. The unavoidable mass of the idler may make it too sluggish to take up these very rapid jerks on the film, whereas there is practically no inertia to prevent the instantaneous action by the bowed portion of the film between the two rollers 21 and 22.

I have already pointed out the advantages of flexibility in the film coupling through which the sprocket 2 drives the drum 20. For best results it is desirable to carry this flexibility even further than is accomplished by the arrangement as so far described, and the best way to provide additional flexibility is to reduce the film tension needed to drive the drum. With reduced film tension the bow between the rollers 21 and 22 becomes larger and hence more flexible, and a softer spring may be employed at 30. The most satisfactory way of reducing the film tension is to provide an auxiliary drive for the drum and flywheel. The auxiliary drive should be of a type that is smooth in its action and will not fix the speed of the drum, permitting the latter to be determined by the residual tension on the film. In other words. the auxiliary drive must have slip. The ideal auxiliary drive is that which makes use of the drag between the poles of the magnet in such a direction that current is induced in it. This method of driving not only has the properties of smoothness and adjustability, but provides additional damping and therefore further insurance against hunting. An auxiliary drive depending on rubbing friction has practically no damping effect to prevent hunting. The fundamental difference is that in rubbing friction the tangential force is practically independent of the relative velocity, whereas the magnetic drag increases with the velocity of the relative movement. Viscous fluid friction is similar in its action to the magnetic drag, but is not so easily applied. The means by which I provide the auxiliary drive will next be described in detail. This means comprises the circular magnet 35 having a series of pole pieces 36 and in the air gap of which rotates an armature comprising the copper flange 37 on the flywheel 26. The magnet is shown as an electromagnet, being provided with the exciting coil 38. Relative rotation of the magnet and armature causes the generation in the latter of eddy currents and a strong magnetic drag. As shown diagrammatically in Fig. 2 I connect the magnet positively with the driving motor and cause it to rotate, the speed being slightly greater than that of the armature. The excess speed of the magnets is preferably of the order of 10 to 20 per cent. Shaft 40 is shown having slip rings 41 connected to the coil 38 and on which slide the brushes 42 connected to a suitable source of direct current. For operation the current is adjusted until the bow in the film between rollers 21 and 22 is from ¼ inch to ½ inch high. The bow or loop in the film between sprocket 1 and roller 7 should be somewhat larger. With this arrangement the film is relieved of a large portion of the tension necessary to rotate the drum and the rings 5 and 6, since a part of the driving power is supplied through the magnet and armature.

I have described several devices whose function is to increase the flexibility of the film between the drum and the sprocket, (1) the flexibly supported idler, (2) the arrangement of rollers so as to cause a bow in the film, and (3) an auxiliary drive of the drum to reduce the tension on the film and thereby augment any loops or bows which its natural stiffness causes it to make. These may be employed either as alternatives or to supplement each other. I have also described two methods of providing damping to prevent hunting, one a device which absorbs energy whenever a loop in the film changes length, and the other a device applied at the flywheel or on the shaft with the drum, which absorbs energy whenever there is

a part of the torque required to maintain the rotation of the drum.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Figs. 1 and 2 are diagrammatic views taken at right angles to each other illustrating a preferred embodiment of my invention and Fig. 3 is a view similar to Fig. 1 showing a modification.

The apparatus comprising my invention is applicable for use either in the recording of sound on a sensitive film or in the reproducing of sound from a film record. I have chosen to illustrate it, however, as applied to a reproducer.

The main film driving elements of the apparatus are the sprockets 1 and 2, the former drawing the film 3 from a reel or from a picture projector, not shown, as the case may be and feeding it to the supporting means 4. This means comprises the two rings 5 and 6 against which the film is pressed by the rollers 7 and 8 which preferably are rubber faced. The film 3 as shown in Fig. 2 has thereon a picture record 9 and a sound record 10 arranged side by side between the two marginal rows of sprocket holes. While I have shown the rings 5 and 6 spaced apart a distance approximately equal to the combined width of the picture and sound records it is to be understood that they need be spaced only the width of the sound record. Within the rings, or in the present example within ring 6, is the photo-electric cell 12 and opposite the curved portion of the film supported on the rings is the optical system 13 by means of which a very narrow light beam of the order of one mil in width is directed on that part of the film bearing the sound record. This light as modified by the sound record passes on into the cell 12 from which current variations are received corresponding to the sound record. Rings 5 and 6 are mounted for free co-axial rotation by means of the rollers 15 of which I have shown by way of example three arranged at angles of 120 degrees around each ring. I have also shown the corresponding rollers of each ring mounted on a common shaft 16. If desired, a greater number of rollers may be employed and also they may have separate mountings. As an alternative construction the rings may be carried on ball races if desired. As a means of maintaining the rings in proper alinement I have formed each with a V-shaped groove 17 into which fit the correspondingly shaped faces of the rollers. The film is thereby supported at each side of the sound record thereon and there is nothing to interfere with the photo-electric cell or its mounting and connections.

successively over the drum 20, fixed rollers 21 and 22, movable idler 23 and sprocket 2 to the receiving reel, not shown, or to other apparatus. Drum 20 is freely rotatable and is shown mounted on the shaft 25 on which also is mounted the disk 26 comprising a flywheel, the mass of which tends to maintain the speed of the film constant. Were the film to be carired directly from the drum to the sprocket 2, a jerk at the sprocket would be transmitted forcibly to the film on the drum either causing the film to slip over the drum or to accelerate the drum and flywheel and an irregularity in speed would thus be communicated to the point of application of the light beam. Accordingly I provide between the sprocket 2 and the drum 20 the idler 23 mounted on the arm 28 pivoted at 29. This idler engages a loop in the film which is given more or less tension by the spring 30 connected to the arm 28. A jerk or momentary speed change at the sprocket now results only in a slight movement of the idler 23 and a very small change in the tension on the film, and the speed of the drum is practically unaffected, nor is there any tendency for the film to slip on the drum. The idler 23 assumes a mean position at which the tension produced by the spring is just sufficient to overcome the frictional resistance of the drum, rings, and rollers. I have found that the arrangement, as so far described, while tending in the main to reduce speed fluctuations, is under certain conditions subject to hunting. For example, suppose that for the moment the drum with its flywheel is running too slowly, the loop engaged by the idler 23 shortens and the tension of the spring 30 is increased. The drum in response to the greater film tension is accelerated and the idler returns to its original position but the drum has acquired a speed greater than normal and accordingly the idler passes beyond its normal position down to a new position where the tension of the spring is below normal. Now the film tension, being below normal, allows the drum to lose speed and again we have the condition with which we started. This process may continue through many cycles, or even indefinitely, especially if any speed variations at the sprocket coincide in frequency of repetition with the frequency at which the system tends to hunt, and while bearing and other friction tends in a slight degree to damp out such oscillations of speed it is entirely inadequate where constant speed is required. It is also true of the system in which the flexibly supported roller 23 is omitted that hunting occurs. The elastic stretch of the film as the tension varies constitutes the elastic element of the oscillatory system. The principal difference is that the addition of the flexibly supported idler or any device which provides increased flexi-

hunting and also makes it more evident to the eye since changes of tension are marked by changes in the position of the roller or length of loop. To prevent hunting in apparatus such as I have described, I have provided means for damping out the recurring speed variations. One of these means is the dash pot 32 of the well known liquid type, the movable member of which connects with the arm 28. To permit sudden quick movements of the idler 23, I employ a yielding member such as the spring 33 in the connection between the dash pot and the arm 28. This spring is stiff compared with spring 30 and does not appreciably reduce the effectiveness of the dash pot in preventing hunting.

I have provided an additional arrangement for supplementing the flexibility introduced by the above described movable idler, which comprises carrying the film over the adjacent successive rollers 21 and 22 in the same direction forming a free span therebetween. The natural stiffness of the film causes it to bow up slightly as so arranged, the amount of excess length being decidedly greater than that resulting from the curvature which a film takes when passed in opposite directions over two successive rollers. The bowing up of the film is most noticeable if the rollers are of small diameter. The slight excess length thus introduced in the film is insurance against the transmission of very short and rapid jerks such as may result from tooth action of the sprocket. The unavoidable mass of the idler may make it too sluggish to take up these very rapid jerks on the film, whereas there is practically no inertia to prevent the instantaneous action by the bowed portion of the film between the two rollers 21 and 22.

I have already pointed out the advantages of flexibility in the film coupling through which the sprocket 2 drives the drum 20. For best results it is desirable to carry this flexibility even further than is accomplished by the arrangement as so far described, and the best way to provide additional flexibility is to reduce the film tension needed to drive the drum. With reduced film tension the bow between the rollers 21 and 22 becomes larger and hence more flexible, and a softer spring may be employed at 30. The most satisfactory way of reducing the film tension is to provide an auxiliary drive for the drum and flywheel. The auxiliary drive should be of a type that is smooth in its action and will not fix the speed of the drum, permitting the latter to be determined by the residual tension on the film. In other words, the auxiliary drive must have slip. The ideal auxiliary drive is that which makes use of the drag between a magnet and a sheet of copper or other non-magnetic material of high electrical conductivity, when the latter moves be-

reflection that current is induced in it. This method of driving not only has the properties of smoothness and adjustability, but provides additional damping and therefore further insurance against hunting. An auxiliary drive depending on rubbing friction has practically no damping effect to prevent hunting. The fundamental difference is that in rubbing friction the tangential force is practically independent of the relative velocity, whereas the magnetic drag increases with the velocity of the relative movement. Viscous fluid friction is similar in its action to the magnetic drag, but is not so easily applied. The means by which I provide the auxiliary drive will next be described in detail. This means comprises the circular magnet 35 having a series of pole pieces 36 and in the air gap of which rotates an armature comprising the copper flange 37 on the flywheel 26. The magnet is shown as an electromagnet, being provided with the exciting coil 38. Relative rotation of the magnet and armature causes the generation in the latter of eddy currents and a strong magnetic drag. As shown diagrammatically in Fig. 2 I connect the magnet positively with the driving motor and cause it to rotate, the speed being slightly greater than that of the armature. The excess speed of the magnets is preferably of the order of 10 to 20 per cent. Shaft 40 is shown having slip rings 41 connected to the coil 38 and on which slide the brushes 42 connected to a suitable source of direct current. For operation the current is adjusted until the bow in the film between rollers 21 and 22 is from ¼ inch to ½ inch high. The bow or loop in the film between sprocket 1 and roller 7 should be somewhat larger. With this arrangement the film is relieved of a large portion of the tension necessary to rotate the drum and the rings 5 and 6, since a part of the driving power is supplied through the magnet and armature.

I have described several devices whose function is to increase the flexibility of the film between the drum and the sprocket, (1) the flexibly supported idler, (2) the arrangement of rollers so as to cause a bow in the film, and (3) an auxiliary drive of the drum to reduce the tension on the film and thereby augment any loops or bows which its natural stiffness causes it to make. These may be employed either as alternatives or to supplement each other. I have also described two methods of providing damping to prevent hunting, one a device which absorbs energy whenever a loop in the film changes length, and the other a device applied at the flywheel or on the shaft with the drum, which absorbs energy whenever there is an acceleration or retardation of the drum shaft. Any device which applies to the shaft or to something attached thereto a torque which varies with the

shaft speed, will provide such damping. Thus electromagnetic drag, and fluid friction are effective damping agents, but not common rubbing friction which gives a tangential force practically independent of speed. It is not essential to the damping that the magnets revolve. Stationary magnets acting on a flange will also produce damping of oscillations, but they will also produce a steady retarding force which it is desirable to avoid, since it increases the tension on the film. The steady retarding force may be avoided by permitting the magnets to revolve at approximately the drum speed, and this may be readily accomplished by so mounting them that they can revolve freely, in which case the electromagnetic drag will itself cause them to assume a speed practically equal to the flywheel speed, and their own inertia will be sufficient to permit the necessary damping forces to act between them and the flywheel. It is obvious that the position of the flywheel and flange may be interchanged with that of the magnets without altering the effectiveness of the arrangement, provided the magnets afford adequate moment of inertia for the drum shaft. The principle of the arrangement just described may be defined in more general terms as follows: In addition to the flywheel or its equivalent which is mounted on the shaft with the drum, a second element is provided which is rotatable about the same axis and is coupled to the drum shaft either by electromagnetic drag or friction, preferably fluid friction. The second element is held at approximately constant speed either by its own inertia or by being positively connected, as for example through gears or a belt to some element which is running at approximately constant speed. Thus a second flywheel, mounted loosely on the same shaft or on a coaxial shaft and coupled to the first flywheel through an energy absorbing coupling, would come under this definition. So also would the employment of a flywheel on the drum shaft, having an annular channel filled with mercury. In this case the mercury is the second rotatable element.

If the second element, which is coupled magnetically or through viscous friction to the drum shaft, rotates at drum speed, it neither appreciably adds to nor subtracts from the torque which must be applied by tension on the film. I prefer however to relieve the film of a large part of the work it has to do in overcoming bearing and roller friction, and I accomplish this by driving the second element (as the magnets in the form of ture, using polyphase alternating current, as is done in the case of an induction motor.

The fundamental principle of my invention consist in the combination of means for increasing the flexibility of the film coupling between the driving sprocket and the drum, with means for damping out hunting. The magnetic drive with the magnets running faster than the drum is a single device which performs both functions, but I prefer to supplement it with the other devices described.

If the apparatus is to be used for recording sound on a sensitive film, a single ring may be used if desired to support the film for its entire width. Also if desired the optical system may be arranged to direct the light beam on the film while it is in engagement with the drum 20 instead of the rings, in which case when the apparatus is used for reproducing purposes the drum would have an opening opposite the sound record and the photo-electric cell would be arranged within the drum.

Such an arrangement is shown in the modified form illustrated by Fig. 3 where the optical system 13 is shown projecting the light beam on a portion of the film supported by the drum 47 which in this case is hollow and contains the photo-electric cell 48. Idler 50 corresponding to idler 23 of the previous form is carried by arm 51 to which connects the air dash pot 52. Since an air dash pot is inherently resilient, a separate spring corresponding to 33 of Fig. 1 is unnecessary.

In the modified form shown in Fig. 3 it will be noted that the bowed portion of the film is formed between the movable idler 50 and one of the two pressure rollers which press the film against the drum.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. Apparatus for imparting a steady movement to a film comprising a sprocket, a rotatable drum engaged by the film and having a flywheel connected therewith such that the speed of the flywheel depends upon the tension of the film between the drum and the sprocket, means for increasing the flexibility of the film between the drum and the sprocket, and damping means for preventing hunting.

2. Apparatus for imparting a steady movement to a film comprising a film driving member and means for absorbing variations in the tension of the film comprising a pair of adjacent rollers over each of which the film bends in a similar manner and between which the film extends in a free span forming a yielding bowed portion.

ing a yielding bowed portion therebetween.

4. Apparatus for drawing a film at a uniform speed over a support comprising a film driving member, a resiliently biased idler arranged to engage a loop in the film between the support and the driving member, and anti-hunting means arranged to absorb energy whenever the loop changes length.

5. Apparatus for drawing a film at a uniform speed over a support comprising a sprocket, an idler arranged to engage a loop in the film between the support and the sprocket, a spring operatively engaging the idler to tension the film and a dash pot connected with the idler to prevent hunting.

6. Apparatus for drawing a film at a uniform speed over a support comprising a sprocket, a lever having an idler engaging a loop in the film between the sprocket and the support, a spring engaging the lever for producing the desired tension in the film, a dash pot and a yielding connection between the dash pot and the lever.

7. Apparatus for driving a film at a uniform speed, comprising a sprocket and a drum each engaged by the film, and relatively movable magnet and armature members, one of said members being operatively connected with said drum.

8. Apparatus for driving a film at a uniform speed comprising a sprocket and a drum both engaged by the film, and magnet and armature members each mounted for independent rotation, one of said members being connected with said drum.

9. Apparatus for driving a film at a uniform speed comprising a sprocket and a drum arranged to engage the film serially, cooperating rotatable magnet and armature members, and means for rotating one of said members, the other member being connected with said drum.

10. Apparatus for driving a film at a uniform speed comprising a sprocket and a drum arranged to engage the film serially, the film being arranged to supply a driving torque to the drum, flywheel means rotatable with said drum and means associated with said flywheel for preventing hunting thereof due to the driving effort of the film.

11. Apparatus for driving a film at a uniform speed comprising a sprocket and a drum engaging the film serially, a flywheel operatively connected with the drum and driven by the film and means for applying a torque to the flywheel in the direction of rotation thereof comprising a driving member and a cooperating rotatable magnet and armature connected respectively with the driving member and the flywheel.

12. Apparatus for driving a film at a uniform speed comprising a sprocket and a drum engaging the film serially, a flywheel operatively connected with the drum and driven by the film and means for applying a torque to the flywheel in the direction of rotation thereof comprising a driving member and a cooperating rotatable magnet and armature connected respectively with the driving member and the flywheel, and means for damping out irregularities in the movement of the film comprising a rotatable magnet member and a cooperating rotatable armature member, one of said members being connected with said drum.

13. Apparatus for driving a film at substantially uniform speed comprising a drum and sprocket engaged by the film, a flywheel operatively connected with the drum, and means for preventing hunting, comprising a rotating means coaxial with the flywheel, and so coupled with the flywheel that a torque is applied to the flywheel, the magnitude and direction of the torque depending upon the relative motion of the flywheel and the said rotating means.

14. Apparatus for driving a film at substantially uniform speed comprising a drum and sprocket engaged by the film, a flywheel operatively connected with the drum, and means for applying a torque to the flywheel comprising a rotating coaxial device, so coupled to the flywheel that the torque applied to the flywheel depends upon the relative motion of the flywheel and the said rotating device.

15. Apparatus for driving a film at a uniform speed comprising a sprocket and a drum, a flywheel connected with said drum, means for applying a torque to the drum and for preventing hunting, and means for absorbing variations in the tension of the film between the sprocket and the drum comprising a pair of adjacent rollers over which the film bends in a free span bowed in accordance with the tension of the film.

16. Apparatus for driving a film at a uniform speed comprising a sprocket and a drum each engaging the film, the tension of the film between the sprocket and the drum supplying a portion of the driving torque for the drum and means for preventing hunting of and for supplying additional driving torque to said drum.

17. Film driving apparatus comprising a sprocket and a drum arranged to engage the film serially and means for damping out irregularities in the movement of the film comprising a rotatable magnet member and a cooperating rotatable armature member, one of said members being connected with said drum.

18. Film driving apparatus comprising a sprocket and a drum arranged to engage the film serially and means for damping out irregularities in the movement of the film comprising a rotatable magnet member and a cooperating rotatable armature member, means for rotating one of said members and means for connecting the other member with said drum.

In witness whereof, I have hereunto set my hand this 26th day of July, 1928.

shaft speed, will provide such damping. Thus electromagnetic drag, and fluid friction are effective damping agents, but not common rubbing friction which gives a tangential force practically independent of speed. It is not essential to the damping that the magnets revolve. Stationary magnets acting on a flange will also produce damping of oscillations, but they will also produce a steady retarding force which it is desirable to avoid, since it increases the tension on the film. The steady retarding force may be avoided by permitting the magnets to revolve at approximately the drum speed, and this may be readily accomplished by so mounting them that they can revolve freely, in which case the electromagnetic drag will itself cause them to assume a speed practically equal to the flywheel speed, and their own inertia will be sufficient to permit the necessary damping forces to act between them and the flywheel. It is obvious that the position of the flywheel and flange may be interchanged with that of the magnets without altering the effectiveness of the arrangement, provided the magnets afford adequate moment of inertia for the drum shaft. The principle of the arrangement just described may be defined in more general terms as follows: In addition to the flywheel or its equivalent which is mounted on the shaft with the drum, a second element is provided which is rotatable about the same axis and is coupled to the drum shaft either by electromagnetic drag or friction, preferably fluid friction. The second element is held at approximately constant speed either by its own inertia or by being positively connected, as for example through gears or a belt to some element which is running at approximately constant speed. Thus a second flywheel, mounted loosely on the same shaft or on a coaxial shaft and coupled to the first flywheel through an energy absorbing coupling, would come under this definition. So also would the employment of a flywheel on the drum shaft, having an annular channel filled with mercury. In this case the mercury is the second rotatable element.

If the second element, which is coupled magnetically or through viscous friction to the drum shaft, rotates at drum speed, it neither appreciably adds to nor subtracts from the torque which must be applied by tension on the film. I prefer however to relieve the film of a large part of the work it has to do in overcoming bearing and roller friction, and I accomplish this by driving the second element (or the magnets in the form of the invention shown in the drawing) at a speed slightly above that of the drum.

Instead of rotating a set of magnets, an equivalent rotating magnetic field may be produced with a stationary magnetic structure, using polyphase alternating current, as is done in the case of an induction motor.

The fundamental principle of my invention consist in the combination of means for increasing the flexibility of the film coupling between the driving sprocket and the drum, with means for damping out hunting. The magnetic drive with the magnets running faster than the drum is a single device which performs both functions, but I prefer to supplement it with the other devices described.

If the apparatus is to be used for recording sound on a sensitive film, a single ring may be used if desired to support the film for its entire width. Also if desired the optical system may be arranged to direct the light beam on the film while it is in engagement with the drum 20 instead of the rings, in which case when the apparatus is used for reproducing purposes the drum would have an opening opposite the sound record and the photo-electric cell would be arranged within the drum.

Such an arrangement is shown in the modified form illustrated by Fig. 3 where the optical system 13 is shown projecting the light beam on a portion of the film supported by the drum 47 which in this case is hollow and contains the photo-electric cell 48. Idler 50 corresponding to idler 23 of the previous form is carried by arm 51 to which connects the air dash pot 52. Since an air dash pot is inherently resilient, a separate spring corresponding to 33 of Fig. 1 is unnecessary.

In the modified form shown in Fig. 3 it will be noted that the bowed portion of the film is formed between the movable idler 50 and one of the two pressure rollers which press the film against the drum.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. Apparatus for imparting a steady movement to a film comprising a sprocket, a rotatable drum engaged by the film and having a flywheel connected therewith such that the speed of the flywheel depends upon the tension of the film between the drum and the sprocket, means for increasing the flexibility of the film between the drum and the sprocket, and damping means for preventing hunting.

2. Apparatus for imparting a steady movement to a film comprising a film driving member and means for absorbing variations in the tension of the film comprising a pair of adjacent rollers over each of which the film bends in a similar manner and between which the film extends in a free span forming a yielding bowed portion.

3. Apparatus for imparting a steady movement to a film comprising a film driving sprocket and a pair of film engaging rollers arranged on the tension side thereof, the film being bent in a similar manner over each of the rollers and extending in a free span form-

form speed over a support comprising a film driving member, a resiliently biased idler arranged to engage a loop in the film between the support and the driving member, and anti-hunting means arranged to absorb energy whenever the loop changes length.

5. Apparatus for drawing a film at a uniform speed over a support comprising a sprocket, an idler arranged to engage a loop in the film between the support and the sprocket, a spring operatively engaging the idler to tension the film and a dash pot connected with the idler to prevent hunting.

6. Apparatus for drawing a film at a uniform speed over a support comprising a sprocket, a lever having an idler engaging a loop in the film between the sprocket and the support, a spring engaging the lever for producing the desired tension in the film, a dash pot and a yielding connection between the dash pot and the lever.

7. Apparatus for driving a film at a uniform speed, comprising a sprocket and a drum each engaged by the film, and relatively movable magnet and armature members, one of said members being operatively connected with said drum.

8. Apparatus for driving a film at a uniform speed comprising a sprocket and a drum both engaged by the film, and magnet and armature members each mounted for independent rotation, one of said members being connected with said drum.

9. Apparatus for driving a film at a uniform speed comprising a sprocket and a drum arranged to engage the film serially, cooperating rotatable magnet and armature members, and means for rotating one of said members, the other member being connected with said drum.

10. Apparatus for driving a film at a uniform speed comprising a sprocket and a drum arranged to engage the film serially, the film being arranged to supply a driving torque to the drum, flywheel means rotatable with said drum and means associated with said flywheel for preventing hunting thereof due to the driving effort of the film.

11. Apparatus for driving a film at a uniform speed comprising a sprocket and a drum engaging the film serially, a flywheel operatively connected with the drum and driven by the film and means for applying a torque to the flywheel in the direction of rotation thereof comprising a driving member and a cooperating rotatable magnet and armature connected respectively with the driving member and the flywheel.

12. Apparatus for driving a film at a uniform speed comprising a sprocket and a drum engaged by the film serially, a flywheel operatively connected with the drum and having a flange forming an armature, a rotatable motor connected to drive said sprocket and said magnet.

13. Apparatus for driving a film at substantially uniform speed comprising a drum and sprocket engaged by the film, a flywheel operatively connected with the drum, and means for preventing hunting, comprising a rotating means coaxial with the flywheel, and so coupled with the flywheel that a torque is applied to the flywheel, the magnitude and direction of the torque depending upon the relative motion of the flywheel and the said rotating means.

14. Apparatus for driving a film at substantially uniform speed comprising a drum and sprocket engaged by the film, a flywheel operatively connected with the drum, and means for applying a torque to the flywheel comprising a rotating coaxial device, so coupled to the flywheel that the torque applied to the flywheel depends upon the relative motion of the flywheel and the said rotating device.

15. Apparatus for driving a film at a uniform speed comprising a sprocket and a drum, a flywheel connected with said drum, means for applying a torque to the drum and for preventing hunting, and means for absorbing variations in the tension of the film between the sprocket and the drum comprising a pair of adjacent rollers over which the film bends in a free span bowed in accordance with the tension of the film.

16. Apparatus for driving a film at a uniform speed comprising a sprocket and a drum each engaging the film, the tension of the film between the sprocket and the drum supplying a portion of the driving torque for the drum and means for preventing hunting of and for supplying additional driving torque to said drum.

17. Film driving apparatus comprising a sprocket and a drum arranged to engage the film serially and means for damping out irregularities in the movement of the film comprising a rotatable magnet member and a cooperating rotatable armature member, one of said members being connected with said drum.

18. Film driving apparatus comprising a sprocket and a drum arranged to engage the film serially and means for damping out irregularities in the movement of the film comprising a rotatable magnet member and a cooperating rotatable armature member, means for rotating one of said members and means for connecting the other member with said drum.

In witness whereof, I have hereunto set my hand this 26th day of July, 1928.

EDWARD W. KELLOGG.

PLAINTIFFS' EXHIBIT NO. 60.

United States Patent No. 1,880,106.

530

Sept. 27, 1932. L. T. ROBINSON 1,880,106

FILM DRIVE

Filed Oct. 4, 1927

Fig.1.

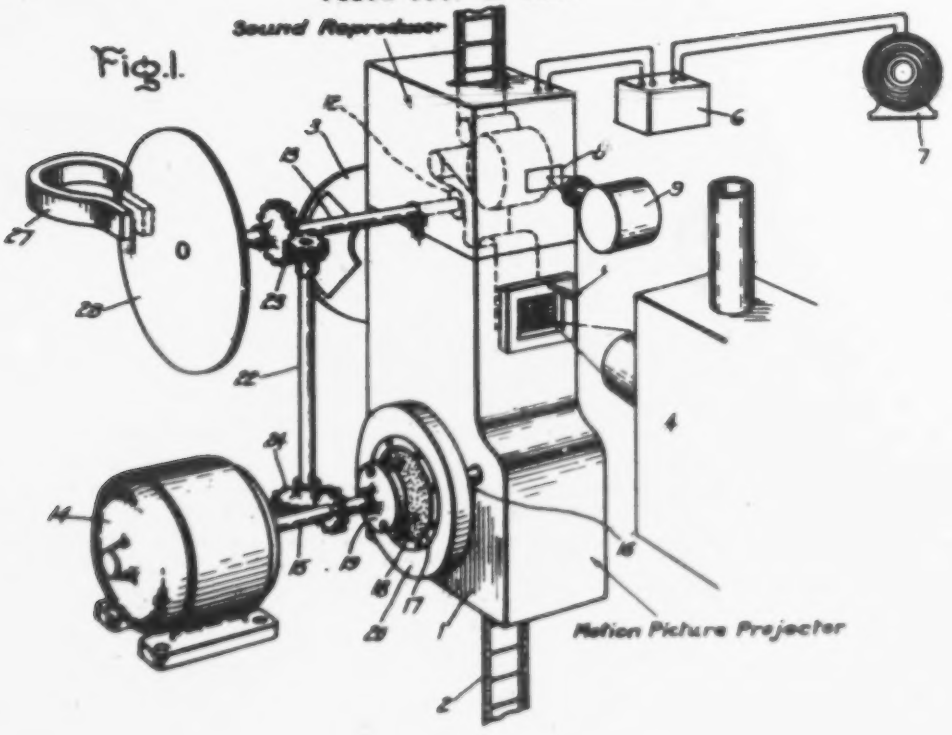
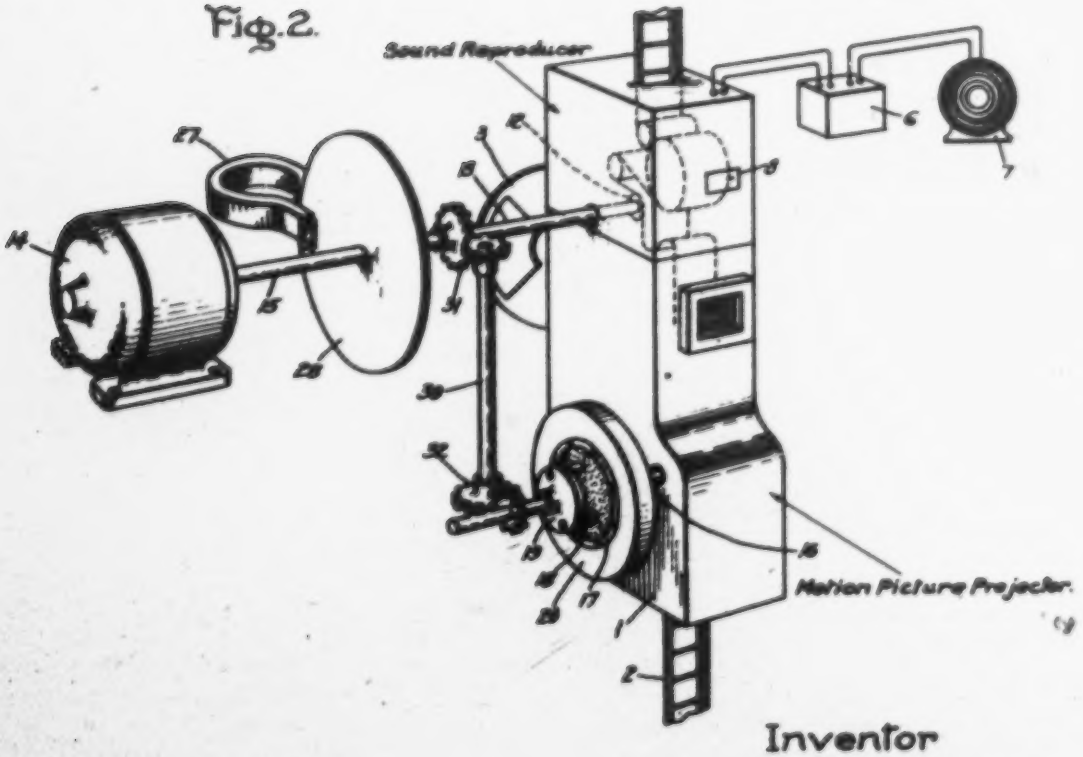


Fig.2.



Inventor
Lewis T. Robinson,
by Alexander S. Lewis

Patented Sept. 27, 1932

531
1,880,106

UNITED STATES PATENT OFFICE

LEWIS T. ROBINSON, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

FILM DRIVE

Application filed October 4, 1927. Serial No. 224,017.

My invention relates to apparatus for recording sound on a moving film or for reproducing the sound from a previously made film record and it also relates to such apparatus together with motion picture recording or reproducing apparatus. My invention relates particularly to the driving means for such apparatus.

In motion picture apparatus as commonly constructed the film is given an intermittent movement at one point between the winding and unwinding reels and various forms of apparatus are used to produce this intermittent movement. In apparatus for recording sound on a film or for reproducing it therefrom the film must move uniformly and for good results the movement should be free from vibrations. Where the two apparatus are arranged close together so that the same film passes through them serially and the driving connection to the sound apparatus is taken from the picture apparatus, it has been found that vibrations arising from the mechanism producing the intermittent motion in the picture apparatus are transmitted through the driving connection to the film in the sound apparatus. It is one object of my invention to provide an improved drive for picture and sound apparatus in which the objectionable effect of the picture apparatus on the uniform movement of the film in the sound apparatus shall be greatly reduced if not eliminated. Another object of my invention is the provision of an improved drive for the sound apparatus wherein small variations in the speed of the film incident to irregularities in the film or to the operation of the mechanism for supporting or moving the film in the apparatus are also reduced or eliminated. Other objects of my invention will appear as the detailed description progresses.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and [illegible] will be pointed out in the appended claims. In the drawing, Fig. 1 shows apparatus in accordance with my invention and Fig. 2 shows a modification thereof.

For illustrative purposes I have chosen to show my invention as applied to apparatus for projecting motion pictures and for reproducing sound incident thereto from a film bearing both picture and sound records, the film passing serially through the respective apparatus. The picture projector 1 may be of any well-known type having mechanism therein for giving the film 2 therein the usual intermittent movement. The projector is shown as having the shutter 3 and the lantern 4 containing the source of light. Above the projector is the sound reproducer 5 connected with which is the amplifier 6 and the loud speaker 7. The sound reproducer 5 is shown of the form in which the film passes over a drum close to a plate having a narrow light aperture shown at 8 through which light from the lantern 9 passes to the sound record on the film and thence to a suitable photo-electric cell, not shown. The resulting electric impulses are amplified by a suitable amplifier 6 and converted into sound waves by the loud speaker 7.

The film is drawn through the sound reproducer with a uniform movement by suitable mechanism comprising for example the sprocket wheel 12 on the shaft 13. The electric motor 14, which may be any constant speed motor, preferably a three phase motor, is connected to drive both the picture projector and the sound reproducer. In Fig. 1, I have shown the motor shaft 15 direct-connected with the projector drive shaft 16 through a yielding or vibration absorbing coupling. This coupling is illustrated as comprising the disk 17 which for example may be of leather having two holes which receive the two pins 18 on disk 19 carried by the motor shaft. To further reduce vibrations arising in the projector I have shown on the drive shaft 16 the fly wheel 20 to which for convenience the disk 17 is attached. Motor shaft 15 and drive shaft 13 are inter-

Filed Oct. 4, 1927

Fig.1.

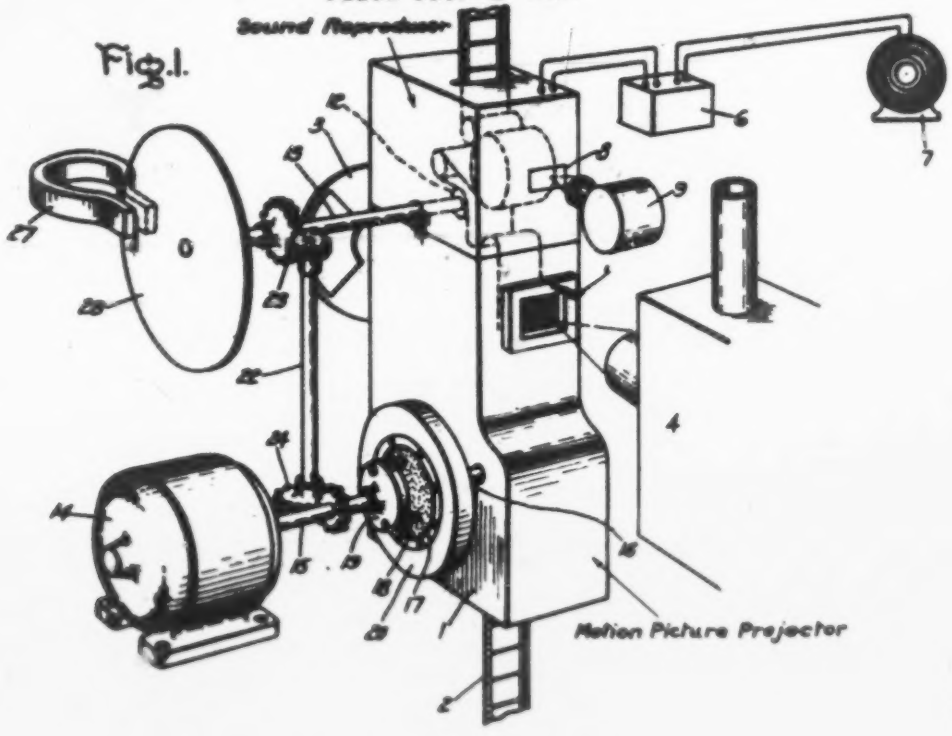
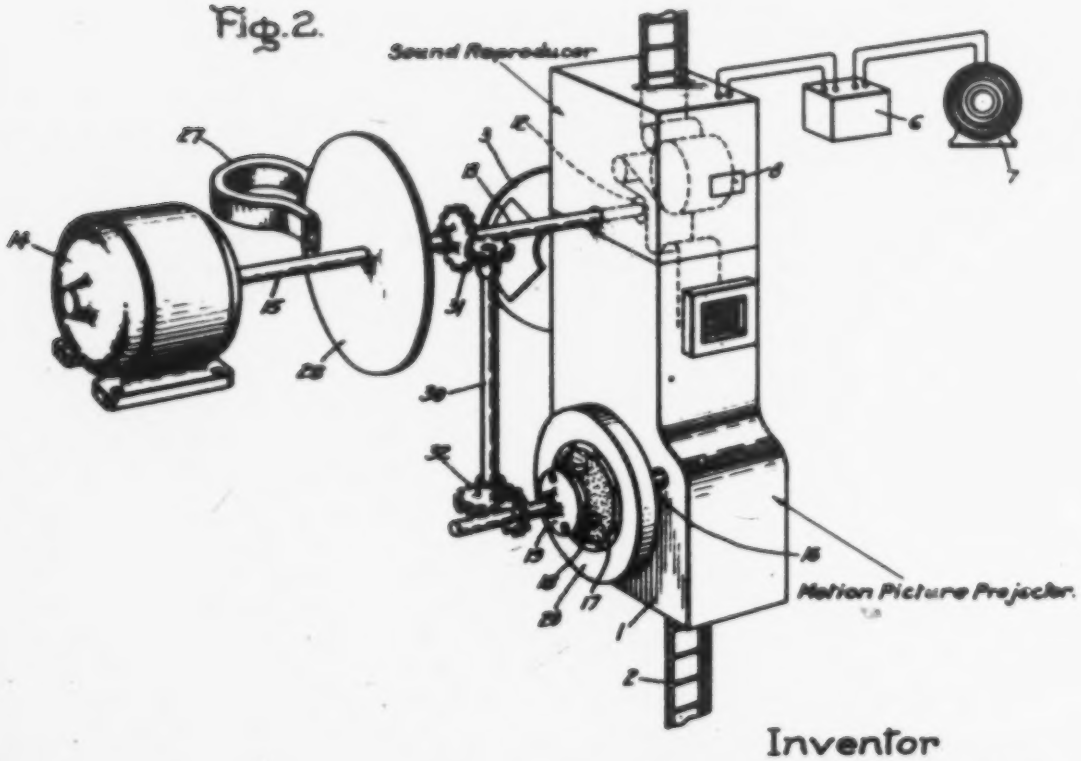


Fig.2.



Inventor
Lewis T. Robinson,
by Alexander S. Lamb
His Attorney.

UNITED STATES PATENT OFFICE

LEWIS T. ROBINSON, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

FILM DRIVE

Application filed October 4, 1927. Serial No. 224,017.

My invention relates to apparatus for recording sound on a moving film or for reproducing the sound from a previously made film record and it also relates to such apparatus together with motion picture recording or reproducing apparatus. My invention relates particularly to the driving means for such apparatus.

In motion picture apparatus as commonly constructed the film is given an intermittent movement at one point between the winding and unwinding reels and various forms of apparatus are used to produce this intermittent movement. In apparatus for recording sound on a film or for reproducing it therefrom the film must move uniformly and for good results the movement should be free from vibrations. Where the two apparatus are arranged close together so that the same film passes through them serially and the driving connection to the sound apparatus is taken from the picture apparatus, it has been found that vibrations arising from the mechanism producing the intermittent motion in the picture apparatus are transmitted through the driving connection to the film in the sound apparatus. It is one object of my invention to provide an improved drive for picture and sound apparatus in which the objectionable effect of the picture apparatus on the uniform movement of the film in the sound apparatus shall be greatly reduced if not eliminated. Another object of my invention is the provision of an improved drive for the sound apparatus wherein small variations in the speed of the film incident to irregularities in the film or to the operation of the mechanism for supporting or moving the film in the apparatus are also reduced or eliminated. Other objects of my invention will appear as the detailed description progresses.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 shows a motion picture projector and a sound reproducer having a drive constructed in accordance with my invention and Fig. 2 shows a modification thereof.

For illustrative purposes I have chosen to show my invention as applied to apparatus for projecting motion pictures and for reproducing sound incident thereto from a film bearing both picture and sound records, the film passing serially through the respective apparatus. The picture projector 1 may be of any well-known type having mechanism therein for giving the film 2 therein the usual intermittent movement. The projector is shown as having the shutter 3 and the lantern 4 containing the source of light. Above the projector is the sound reproducer 5 connected with which is the amplifier 6 and the loud speaker 7. The sound reproducer 5 is shown of the form in which the film passes over a drum close to a plate having a narrow light aperture shown at 8 through which light from the lantern 9 passes to the sound record on the film and thence to a suitable photo-electric cell, not shown. The resulting electric impulses are amplified by a suitable amplifier 6 and converted into sound waves by the loud speaker 7.

The film is drawn through the sound reproducer with a uniform movement by suitable mechanism comprising for example the sprocket wheel 12 on the shaft 13. The electric motor 14, which may be any constant speed motor, preferably a three phase motor, is connected to drive both the picture projector and the sound reproducer. In Fig. 1, I have shown the motor shaft 15 direct-connected with the projector drive shaft 16 through a yielding or vibration absorbing coupling. This coupling is illustrated as comprising the disk 17 which for example may be of leather having two holes which receive the two pins 18 on disk 19 carried by the motor shaft. To further reduce vibrations arising in the projector I have shown on the drive shaft 16 the fly wheel 20 to which for convenience the disk 17 is attached. Motor shaft 15 and drive shaft 13 are interconnected by the counter shaft 22 and the gears 23 and 24, preferably spiral gears, providing the necessary speed reduction which in the case of the projector is provided for

by suitable gearing, not shown, within the projector casing. By arranging a separate driving connection from the motor to the sound reproducer and to the picture projector and by interposing a vibration absorbing means in the connection with the projector, vibrations arising in the projector mechanism will be transmitted to the drive shaft of the sound reproducer only to a negligible extent, if at all.

In addition to the above noted effect of the projector on the uniformity of the film movement in the sound reproducer there are other factors which disturb the uniform movement of the film such for example as those resulting from irregularities in the film and the operation of the winding and unwinding reels which it will be understood connect with the apparatus illustrated but which for simplicity have been omitted from the drawing. For the best results in recording and reproducing sound it is essential that the film be moved past the light beam with a speed which is uniform to a high degree of exactness. Particularly is this true when music is being recorded or reproduced as extremely slight variations in the speed of the film especially when they recur at regular intervals are noticeable to a trained musical ear. I greatly reduce or entirely eliminate much of these variations in film speed by the provision of a loading device whose effect is to add an additional constant load to the motor. Various well-known means may be employed for this load but I prefer to use a magnetic drag comprising a fixed magnet and a conducting member rotatable in the field thereof. In Fig. 1 of the drawing I have shown the permanent magnet 27 between and close to the poles of which rotates the metal disk 28 mounted on the shaft 13. This form of loading device is particularly well adapted for the purpose described inasmuch as it is not subject to variations in its braking effect such as occur for example in a friction brake and its braking effect always bears a definite relation to the speed. Where an additional steady load is used, such as that just described, the load variations of the film driving mechanism comprise a relatively smaller proportion of the total load driven by the motor than where such is not used. In arrangements such as that shown by Fig. 1 where gearing is used to transmit motion to the film sprocket a further advantage of the loading device is that it takes up all back lash of the gears.

In the modification illustrated by Fig. 2 the motor shaft 15 is direct connected or is [illegible] gearing for reducing the driving speeds of the two apparatus. In the modified form the projector is shown driven from the motor shaft through the counter shaft 30 and spiral gearing 31 and 32. The projector drive shaft 16 is provided with the same vibration absorbing device and flywheel as that shown in the form illustrated by Fig. 1.

For convenience in illustrating my invention I have shown the second reproducer and the picture projector arranged one above the other with the driving motor and connections thereto including the vibration absorbing member and loading means arranged outside of the reproducer and projector casings. However, I prefer a more compact arrangement wherein the sound reproducer and picture projector comprise a single or unitary structure with the drive connections, vibration absorber loading means, etc. incorporated in the structure.

I have chosen the particular embodiments described above as illustrative of my invention and it will be apparent that various modifications may be made without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. In combination, a sound reproducer and a motion picture projector through which a film having sound and picture records thereon is adapted to be passed in series, mechanism in the sound reproducer for moving the film uniformly, mechanism in the projector for moving the film intermittently, a single driving motor connected with both of said mechanisms and means for preventing vibrations incident to the intermittent film moving mechanism from being transmitted through said drive connections to the uniform film moving mechanism comprising a yielding member interposed in the connection with the projector and a flywheel between said yielding member and the projector.

2. In combination, a sound reproducer mechanism including means for moving a film uniformly, a motion picture projector mechanism having means for moving the film intermittently, a single driving motor connected with both of said mechanisms and means for preventing vibrations incident to the intermittent film moving mechanism from being transmitted through said drive connections to the uniform film moving mechanism comprising a yielding member interposed in the connection with the projector and a flywheel between said yielding member and the projector.

film progressing mechanism, one of said casings being mounted upon and carried by the other casing, a driven shaft operably connected to the latter film progressing mechanism, means for operably connecting the drive shaft to the driven shaft so that both film progressing mechanisms are operated in time relation, and a yielding member interposed in the connection with the projecting apparatus preventing vibrations incident to the film progressing mechanism of the projecting apparatus from being transmitted through the drive connection to the film progressing mechanism of the sound apparatus.

In witness whereof, I have hereunto set my hand this 3d day of October, 1927.

LEWIS T. ROBINSON.

by suitable gearing, not shown, within the projector casing. By arranging a separate driving connection from the motor to the sound reproducer and to the picture projector and by interposing a vibration absorbing means in the connection with the projector, vibrations arising in the projector mechanism will be transmitted to the drive shaft of the sound reproducer only to a negligible extent, if at all.

In addition to the above noted effect of the projector on the uniformity of the film movement in the sound reproducer there are other factors which disturb the uniform movement of the film such for example as those resulting from irregularities in the film and the operation of the winding and unwinding reels which it will be understood connect with the apparatus illustrated but which for simplicity have been omitted from the drawing. For the best results in recording and reproducing sound it is essential that the film be moved past the light beam with a speed which is uniform to a high degree of exactness. Particularly is this true when music is being recorded or reproduced as extremely slight variations in the speed of the film especially when they recur at regular intervals are noticeable to a trained musical ear. I greatly reduce or entirely eliminate much of these variations in film speed by the provision of a loading device whose effect is to add an additional constant load to the motor. Various well-known means may be employed for this load but I prefer to use a magnetic drag comprising a fixed magnet and a conducting member rotatable in the field thereof. In Fig. 1 of the drawing I have shown the permanent magnet 27 between and close to the poles of which rotates the metal disk 28 mounted on the shaft 13. This form of loading device is particularly well adapted for the purpose described inasmuch as it is not subject to variations in its braking effect such as occur for example in a friction brake and its braking effect always bears a definite relation to the speed. Where an additional steady load is used, such as that just described, the load variations of the film driving mechanism comprise a relatively smaller proportion of the total load driven by the motor than where such is not used. In arrangements such as that shown by Fig. 1 where gearing is used to transmit motion to the film sprocket a further advantage of the loading device is that it takes up all back lash of the gears.

In the modification illustrated by Fig. 2 the motor shaft 15 is direct connected or is continuous with the shaft 13, all gearing between the motor and the film driving member in the sound reproducer being thereby eliminated. In this case I use a slow speed motor, however, if preferred, a higher speed motor may be used together with suitable gearing for reducing the driving speeds of the two apparatus. In the modified form the projector is shown driven from the motor shaft through the counter shaft 30 and spiral gearing 31 and 32. The projector drive shaft 16 is provided with the same vibration absorbing device and flywheel as that shown in the form illustrated by Fig. 1.

For convenience in illustrating my invention I have shown the second reproducer and the picture projector arranged one above the other with the driving motor and connections thereto including the vibration absorbing member and loading means arranged outside of the reproducer and projector casings. However, I prefer a more compact arrangement wherein the sound reproducer and picture projector comprise a single or unitary structure with the drive connections, vibration absorber loading means, etc. incorporated in the structure.

I have chosen the particular embodiments described above as illustrative of my invention and it will be apparent that various modifications may be made without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. In combination, a sound reproducer and a motion picture projector through which a film having sound and picture records thereon is adapted to be passed in series, mechanism in the sound reproducer for moving the film uniformly, mechanism in the projector for moving the film intermittently, a single driving motor connected with both of said mechanisms and means for preventing vibrations incident to the intermittent film moving mechanism from being transmitted through said drive connections to the uniform film moving mechanism comprising a yielding member interposed in the connection with the projector and a flywheel between said yielding member and the projector.

2. In combination, a sound reproducer mechanism including means for moving a film uniformly, a motion picture projector mechanism having means for moving the film intermittently, a single driving motor connected with both of said mechanisms and means for preventing vibrations incident to the intermittent film moving mechanism from being transmitted through said drive connections to the uniform film moving mechanism comprising a yielding member interposed in the connection with the projector and a flywheel between said yielding member and the projector.

3. In a machine of the character described, the combination of a photographic sound apparatus casing having a film progressing mechanism and a main drive shaft, a motion picture projecting apparatus casing having a

film progressing mechanism, one of said casings being mounted upon and carried by the other casing, a driven shaft operably connected to the latter film progressing mechanism, means for operably connecting the drive shaft to the driven shaft so that both film progressing mechanisms are operated in time relation, and a yielding member interposed in the connection with the projecting apparatus preventing vibrations incident to the film progressing mechanism of the projecting apparatus from being transmitted through the drive connection to the film progressing mechanism of the sound apparatus.

In witness whereof, I have hereunto set my hand this 3d day of October, 1927.

LEWIS T. ROBINSON.

PLAINTIFFS' EXHIBIT NO. 61.

Copy of File Wrapper and Contents of Cawley Patent No. 1,878,577, Ser. No. 357,259, Filed April 23, 1929.

(Physical Exhibit.)

PLAINTIFF'S EXHIBIT NO. 62.

Copy of File Wrapper and Contents of Cawley Patent No. 1,594,662, Application Filed as Ser. No. 328,-299, Allegedly Filed October 3, 1919.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 63.

Certified Copy of Full Sized Drawings as Originally Filed October 3, 1919, in Cawley Application No. 328,299.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 64.

Copy of File Wrapper and Contents of Cawley Patent No. 1,420,304, Application Filed December 13, 1919, Ser. No. 344,708.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 65.

Certified Copy of File Wrapper and Contents of Cawley Patent No. 1,698,536, Application Filed July 21, 1923, Ser. No. 653,704.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 66.

Certified Copy of File Wrapper and Contents of Cawley Patent No. 1,816,360, Application Filed January 8, 1921, Ser. No. 435,983.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 67.

Certified Copy of File Wrapper and Contents of Cawley Patent No. 1,825,439, Application Allegedly Filed September 16, 1929, Ser. No. 393,072.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 68.

Certified Copy of File Wrapper and Contents of Cawley Patent No. 1,825,441, Application Allegedly Filed January 8, 1921, Ser. No. 435,984.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 69.

Certified Copy of File Wrapper and Contents of Cawley Patent No. 1,825,438, Application Allegedly Filed September 16, 1929, Ser. No. 393,071.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 70.

ASSIGNMENT

WHEREAS, I, ALOYSIUS J. CAWLEY, am the sole owner of the entire right, title and interest in and to United States Letters Patent 1,698,536, dated January 8, 1929, entitled "Sound-Recording Apparatus", and in and to United States Application Serial Number 435,984, filed January 8, 1921 and the inventions disclosed therein; and

WHEREAS, RADIO CORPORATION OF AMERICA, a Delaware corporation having its principal place of business at 233 Broadway, New York, New York, is desirous of acquiring the aforesaid patent and application and the inventions thereof including all divisions and continuations and patents issuing thereon.

NOW, THEREFORE, in consideration of the sum of $1.00 and other good and valuable consideration, the receipt of which is hereby acknowledged, I, ALOYSIUS J. CAWLEY, do hereby sell, assign and transfer over to said RADIO CORPORATION OF AMERICA, its successors, assigns and legal representatives, the entire right, title and interest in and to the aforesaid Letters Patent and the aforesaid Application and the inventions thereof and in and to any reissue or reissues or ex-
A.J.C. of said Letters Patent
tension or extensions / and any patent or patents issuing on a division or divisions or continuation or continuations of the application on which said Letters Patent were issued and all divisions and continua-
A.J.C. Serial No. 435,984
tions of said application / and all Letters Patent, reissues and extensions arising out of said application,

divisions and continuations, the same to be held and enjoyed by the said RADIO CORPORATION OF AMERICA, its successors, assigns or other legal representatives for its own use and behoof and for the use and behoof of its successors, assigns, or other legal representatives to the end of the term or terms for which any Letters Patent have been or may be granted, reissued or extended as fully and entirely as the same would have been held and enjoyed by me, the said ALOYSIUS J. CAWLEY, had this assignment and sale not been made;

AND I, the said ALOYSIUS J. CAWLEY, do hereby request the Commissioner of Patents to issue any and all letters patent, on said application, divisions, continuations, reissues or extensions to said RADIO CORPORATION OF AMERICA, its successors, assigns and other legal representatives in accordance with this transfer;

AND, I, the said ALOYSIUS J. CAWLEY, do hereby covenant with and warrant to the said RADIO CORPORATION OF AMERICA, its successors, assigns and other legal representatives that I have full right to convey the entire interest herein assigned and that I have not made and will not make any agreement in conflict herewith;

AND I, ALOYSIUS J. CAWLEY, further hereby covenant and agree that I will at any time, upon request, execute and deliver any and all papers that may be necessary or desirable to perfect the titles to said inventions, applications and Letters Patent in the United States, its possessions and dependencies to said RADIO CORPORATION OF AMERICA, its successors, assigns or other legal representatives and that if said RADIO CORPORATION OF AMERICA, its successors, assigns or other legal representatives desire to secure a reissue or extension of the aforesaid Letters Patent or

on Letters Patent to be issued on any of said applications or to file divisions or continuations or to file a disclaimer to any of said Letters Patent, that I will, upon request, sign all papers, make all rightful oaths and do all lawful acts requisite thereto, without further compensation, but at the expense of said Assignee, its successors, assigns or other legal representatives and generally do everything possible to aid the said RADIO CORPORATION OF AMERICA, its successors, assigns and other legal representatives to obtain proper protection for said inventions;

AND I do further covenant and agree that I will at any time, upon request, communicate to said RADIO CORPORATION OF AMERICA, its successors, assigns or other legal representatives such facts relating to such inventions, Letters Patent or applications or the history thereof as may be known to me and testify as to the same in any interference or other litigation when requested so to do, without further compensation but at the expense of said Assignee, its successors, assigns or other legal representatives.

In witness whereof, I have hereunto affixed my hand and seal at New York ~~29~~, this 29th day of August, 1929.

ALOYSIUS J. CAWLEY.

STATE OF NEW YORK
COUNTY OF NEW YORK } ss:

On this 29th day of August, 1929, before me, a Notary Public, personally appeared ALOYSIUS J. CAWLEY, to me personally known and known to me to be the person described in and who executed the foregoing instrument, who acknowledged that he executed the same for the purposes therein mentioned.

ALBIN O. CARLSON
(Seal) Notary Public.
Notary Public, Rockland County.
Certificate filed in N. Y. County.
No. 824, Reg. No. O-347.
Term expires March 30, 1930

RECORDED
Transfers of Patents
U. S. Patent Office
AUG 30 1929
LIBER R140 PAGE 318
Thomas E Robertson
Commissioner of Patents

PLAINTIFFS' EXHIBIT NO. 71.

ASSIGNMENT

WHEREAS, I, ALOYSIUS J. CAWLEY, am the sole owner of the entire right, title and interest in and to United States application for Letters Patent filed by me, identified as Serial Number 435,983, filed January 8, 1921, entitled "Electrical Sound Reproducing Process", and the inventions disclosed therein; and

WHEREAS, RADIO CORPORATION OF AMERICA, a Delaware corporation, having its principal place of business at 233 Broadway, New York, New York is desirous of acquiring certain rights in the aforesaid application;

NOW, THEREFORE, in consideration of the sum of One Dollar ($1.00) and other good and valuable consideration, the receipt of which is hereby acknowledged, I, ALOYSIUS J. CAWLEY, do hereby sell, assign and transfer over to said RADIO CORPORATION OF AMERICA, its successors, assigns and legal representatives, all rights in and to inventions immediately concerning methods and apparatus adapted for photo-electric recording or reproducing of sound records from photographic film contained in said application, in contra-distinction to direct electrical reproduction of photographic sound records as described in said application and also excluding all the special sound reproducers described and claimed therein and other subject matter and claims thereto contained in said application but including any applications which have been or may be filed or any patents which have been or may be issued on the said inventions above assigned as fully and entirely as the same would have been held and enjoyed by me, the said ALOYSIUS J. CAWLEY, had this assignment and sale not been made,

AND I, the said ALOYSIUS J. CAWLEY, do hereby covenant with and warrant to the said RADIO CORPORA-

TION OF AMERICA, its successors, assigns and other legal representatives that I have full right to convey the interest herein assigned and that I have not made and will not make any agreement in conflict herewith;

AND I, ALOYSIUS J. CAWLEY further hereby covenant and agree that I will at any time upon request execute and deliver any and all papers that may be necessary for the purpose of filing patent applications upon the inventions hereby assigned and to perfect the title to said inventions and applications and letters patent issuing thereon in the United States, its possessions and dependencies to said RADIO CORPORATION OF AMERICA, its successors, assigns or other legal representatives and that I will, upon request, sign all papers, make all rightful oaths and do all lawful acts, requisite thereto without further compensation but at the expense of said assignee, its successors, assigns or other legal representatives and generally do everything possible to aid said RADIO CORPORATION OF AMERICA, its successors, assigns and other legal representatives to obtain proper protection for said inventions;

AND I do further covenant and agree that I will at any time, upon request, communicate to said RADIO CORPORATION OF AMERICA, its successors, assigns or other legal representatives such facts relating to such inventions, Letters Patent or applications or the history thereof as may be known to me and testify as to the same in any interference or other litigation when requested so to do, without further compensation but at the expense of said Assignee, its successors, assigns or other legal representatives.

In witness whereof, I have hereunto affixed my hand and seal at New York, this 29th day of August, 1929.

ALOYSIUS J. CAWLEY

STATE OF NEW YORK }
COUNTY OF NEW YORK } ss:

On this 29th day of August, 1929, before me, a Notary Public, personally appeared ALOYSIUS J. CAWLEY, to me personally known and known to me to be the person described in and who executed the foregoing instrument, who acknowledged to me that he executed the same for the purposes therein mentioned.

ALBIN O. CARLSON
(Seal) Notary Public
Notary Public, Rockland County.
Certificate filed in N. Y. County.
No. 814, Reg. No. 0-347.
Term expires March 30, 1930.

Recorded
Transfers of Patents
U. S. Patent Office
Aug 30 1929
Liber R140 Page 315
Thomas E. Robertson
Commissioner of Patents

PLAINTIFFS' EXHIBIT NO. 72.

Assembly From R. C. A. PS 1 Apparatus, Comprising a Gear Plate and Two Springs Removed From Flywheel Assembly.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 73.

Sample Simplex Sixteen-Toothed Takeup Sprocket.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 74.

Sample Motion Picture Film Sprocket Having Thirty-two Teeth at Each Edge.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 75.

This Exhibit Designated Later as Plaintiffs' Exhibit No. 94.

PLAINTIFFS' EXHIBIT NO. 76.

File Wrapper of the Pannenatiehl Patent No. 1,728,304.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 77.

Sheet in Patentees' Notebook Between May 11 and May 20, 1921, and Translation Thereof.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 78.

Photographic Slip Dated May 5, 1921, From Patentees' Notebook Showing Photographed Images of Typical Narrow Slits Tested (Similar to Plaintiff's Exhibit No. 25) and Translation.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 79.

Sheet From Patentees' Notebook, February 10, 1921, and Translation.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 80.

Additional Sheet in Patentees' Notebook Dated February 10, 1921, and Translation.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 81.

Sheet in Patentees' Notebook Showing Linear Relationship Between Glow Discharge Current and Density, Dated January 26, 1921, and Translation.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 82.

Page Dated January 26, 1921, in Patentees' Notebook, Including Curve Sheet Signed by Dr. Engl and Showing Linear Relationship Between P. E. Cell Currents and Slit Opening, and Translation.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 83.

Sheet in Patentees' Notebook, Dated September 23, 1920, and Translation, Showing Optical Slit Arrangements and Translation.

(Physical Exhibit.)

Characteristics of Photo-electric Tubes

Relation Between Light and Current—Small and Large Tubes of Vacuum and Gas-filled Types Investigated—Characteristic Curves of Light, Current, Sensitivity, and Gas Pressure

By DR. L. R. KOLLER and H. A. BREEDING
Research Laboratory, Illuminating Engineering Laboratory
General Electric Company

THE most useful property of the photo-electric tube is the definite relation that exists between the intensity of light falling upon the tube and the amount of current that a constant voltage will force through the tube.(1) Elster and Geitel, Lenard, Ladenburg, Hermann, Richtmyer, and many others have performed experiments leading to the conclusion that the relation is almost linear. Others, including Ives, Dushman and Karrer, Hughes, Richardson and Compton, and Kunz have concluded that the relation is not linear, or at least is so only for special types of construction or under special conditions.

Fig. 1. Contour of the Photo-electric Tubes Investigated (*Except the one shown in Fig. 8*)

The results presented in this article show that within certain limits of voltage and illumination intensity the relation is a linear one for the types of tubes studied. The tubes were set up in a dark room on a photometer bench and the light intensity varied by changing the position of the test lamp. The tube was placed in the position ordinarily occupied by the photometer head. A diaphragm with a circular opening one inch in diameter was placed in front of the tube. The test lamps employed were of the 120-volt gas-filled flood-lighting type and were of 250- and 1000-watt rating. Under these conditions, the inverse-square law could be assumed since the distance between lamp and tube was large compared with the dimensions of the filament and the diaphragm. The distance between lamp and tube was varied from eighteen to four feet. The range of intensities ran from 1 to 400 foot-candles, and the voltages applied to the tubes ranged from 22½ to 206 volts.

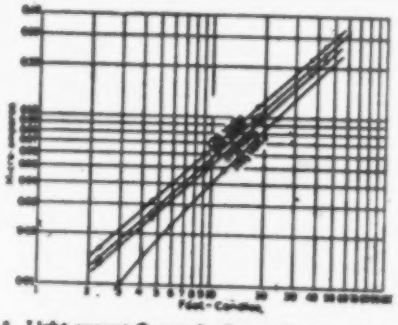


Fig. 2. Light-current Curves for Several Values of Voltage Applied to the Small Vacuum Tube

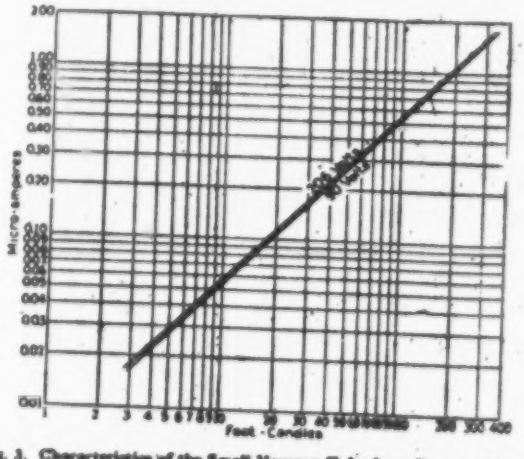


Fig. 3. Characteristics of the Small Vacuum Tube for a Range of Light Intensities Higher Than That Represented in Fig. 2

Figs. 2 to 6 show the light-current relation for four tubes of the type of construction shown in Fig. 1. These tubes are spherical glass bulbs with silvered inside surface upon which a monatomic film of caesium is deposited, the caesium and silver serving as the cathode.* The anode is a pair of wires projecting

(1) A general description of the construction of the photo-electric tube, and an explanation of its performance with respect to the color of the incident light, the particular alkali metal coating used, and the type of tube (whether vacuum or gas-filled) were contained in the article, "The Photo-electric Cell," by L. R. Koller, GENERAL ELECTRIC REVIEW, July, 1928, p. 373

*A paper on the photo-electric behavior of monatomic caesium films will be published soon by Mr. Kenneth T. Bainbridge, of Princeton University.

into the bulb to its center. Two of the tubes were 2½ in. in diameter with a 1½-in. window. The anode leads carried at their tip a small nickel disk ⅛ in. in diameter. Two other tubes were 7 in. in diameter with 6-in. windows and anode disk ½ in. in diameter. One large tube and one small tube were high-vacuum tubes. The other two were filled with argon at pressures of 0.020 and 0.040 mm. respectively.

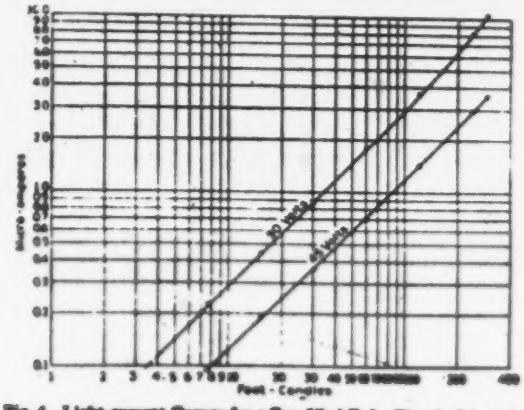


Fig. 4. Light-current Curves for a Gas-filled Tube That is Otherwise Identical to the One Concerned in Figs. 2 and 3

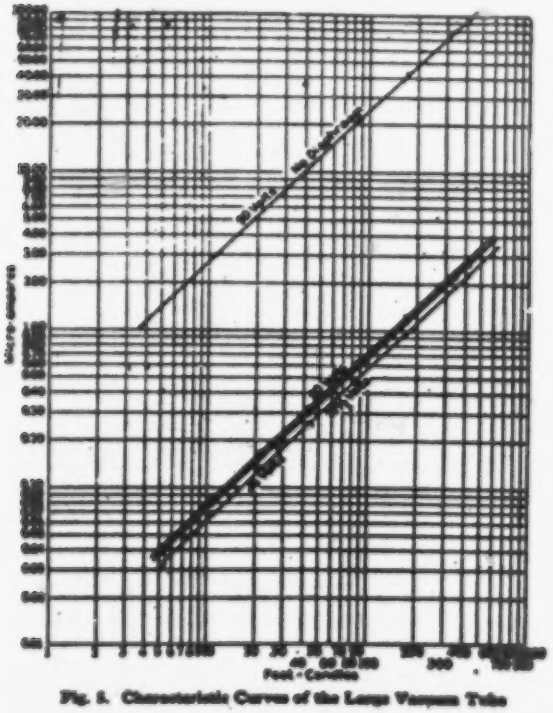


Fig. 5. Characteristic Curves of the Large Vacuum Tube

Consideration will first be given to the data for the small vacuum tube, as shown in Fig. 2. For the three higher voltages the curves are linear and all have practically the same slope. The 22½-volt curve departs markedly from a straight line at the lower intensities, where the slope becomes steeper. At the higher intensities, the slope again approaches the normal value. Fig. 3 shows the characteristics of the same tube at light intensities up to 300 foot-candles. The curves remain linear with the same slope and do not indicate the approach of a saturation condition at the high intensities.

Fig. 4 shows similar curves for a tube of identical construction but containing argon at a pressure of about 0.040 mm. Under the same conditions of illumination and voltage, this tube permits five times as great a current flow due to the ions produced by the collision of the gas molecules and the photo electrons.

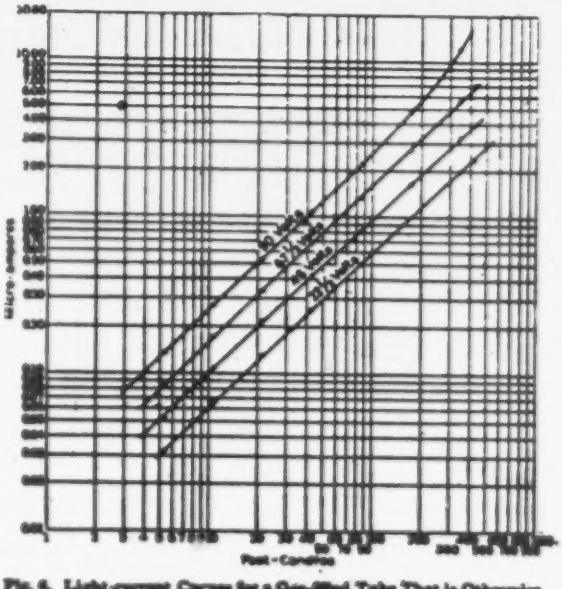


Fig. 6. Light-current Curves for a Gas-filled Tube That is Otherwise Identical to the One Concerned in Fig. 5

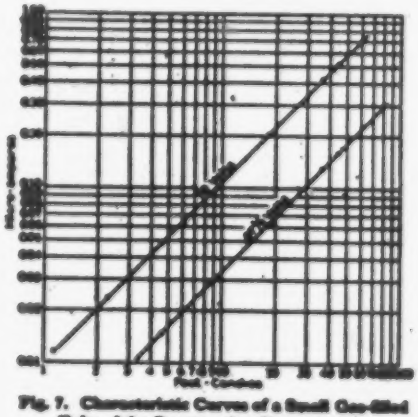


Fig. 7. Characteristic Curves of a Small Gas-filled Tube of the Construction Shown in Fig. 6

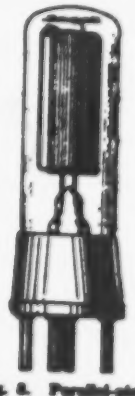


Fig. 8. Parallel-plane Type of Photo-electric Tube Construction

At low voltages the relation is linear over the range tested, but at 90 volts the curve rises more rapidly for illuminations beyond approximately 50 foot-candles.

Fig. 5 shows the results of similar measurements made on the vacuum seven-inch cell using the same size diaphragm and no diaphragm. In the tests when the diaphram was used, the sensitivity is slightly higher than in the case of the small vacuum tube but the curve is linear over the same range. The difference

in sensitivity is probably due to the fact that the number of internal reflections was not the same in both cases as the light was introduced into the large tube somewhat off center to avoid striking the anode. Without the diaphragm the curve is still linear, and the slope remains unchanged. The current is larger in the ratio 33.7 to 1, in fair agreement with the relative areas of the diaphragm and the tube window

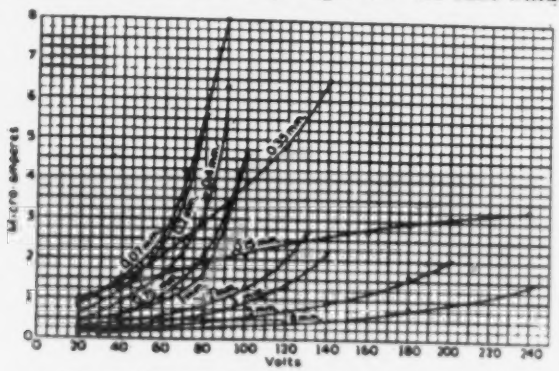


Fig. 9. Voltage-current Curves of a Gas-type Cell with Different Gas Pressures

which were in the ratio of about 1 to 36. The edge of the tube window is not sharply defined, making a precise calculation difficult.

Fig. 6 shows the light-current relations for the large tube which is of the same construction but which contains argon at a pressure of 0.020 mm. These curves show that the gas produces a three-fold increase in sensitivity. They are linear over the same wide range of intensities, except where the 90-volt curve begins to curve upward at intensities above 100 foot-candles.

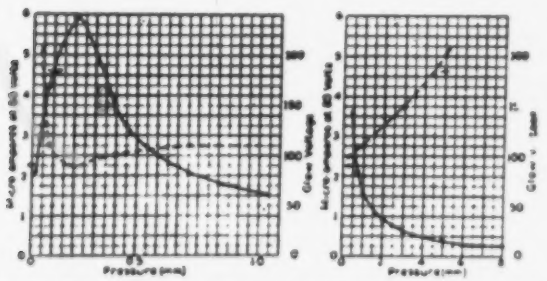


Fig. 10. Pressure-sensitivity Curves (in full) and Pressure-glow-voltage Curves (dotted) of a Gas-type Tube

Fig. 7 shows the relation for a small gas-filled tube of the parallel-plane type of construction that is shown in Fig. 8. The cathode is a flat silver plate $^3/_8$ in. by $1^3/_4$ in. coated with a monatomic film of caesium, while the anode is a wire loop of the same dimensions parallel to the plate and about $^1/_4$ in. from it. The measurements were not carried above 45 foot-candles, but within that range the current was very nearly proportional to the illumination.

If a law of direct proportionality were followed, the slopes of the lines would be unity. There is a slight, but not systematic, deviation from this value. The relation can best be expressed by the formula

$$i = KI^n$$

where i = photo current in micro-amperes
K = a constant
n = a constant
I = illumination intensity in foot-candles.

The values of n for the curves in Figs. 2 to 6 are given in Table I. The average value differs from unity by an amount well within the limits of experimental error, showing that for tubes of this type operated at the voltages given and using a small diaphragm the photo current is proportional to the light intensity.

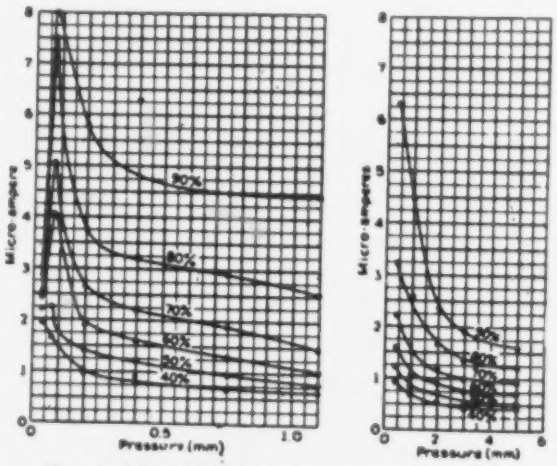


Fig. 11. Pressure-sensitivity Curves at Various Percentages of Glow-voltage

Fig. 9 shows the effect of variations in gas pressure on the sensitivity of a caesium tube under constant illuminating conditions. The tube was of the $2^1/_2$-in. spherical type; and the various pressures of argon were introduced while the tube was still on the pumping system. It was illuminated by a 60-watt vacuum

TABLE I

Fig.	Tube	Volts Applied	n
2	Small, Vacuum	195 105 67.5	0.933 0.949 0.944
3	Small, Vacuum	206 90	1.01 0.95
4	Small, Gas-filled	90 45	1.02 0.99
5	Large, Vacuum	90 22.5	1.06 1.10
6	Large, Gas-filled	67.5 22.5	1.01 0.982
8	Parallel-plate, Gas-filled	90 45	1.04 1.04 Average 1.005

lamp operating on 120 volts at a distance of 6 in. from the tube. A diaphragm with a one-in. opening was placed directly in front of the tube. A volt-ampere curve was taken for each pressure. From Fig. 9 it can be seen that as the pressure is increased the curve is first displaced upward (indicating higher sensitivity) and the slope becomes steeper. The maximum sensitivity is reached at a pressure of about 0.075 mm. As the pressure is further increased, the sensitivity and the slope of the curves decrease again. The pressure giving the highest sensitivity is not always the most desirable for operation on account of the steep slope and consequent instability of the tube. The glow voltage under these conditions passes through a minimum at 0.25 mm.

Fig. 10 gives the relation between glow voltage and pressure, and sensitivity (at a fixed voltage) and pressure.

In Fig. 11 sensitivity at a definite percentage of glow voltage is shown as a function of pressure.

Interest Revives in Trackless Trolleys

A REVIVAL of interest in the trackless trolley bus is foreseen in the decision of the Manila Electric Company of Manila (P. I.) to add to its rolling stock eight trolley buses of a new design. These have been built for that city by the Twin Coach Company of Kent, Ohio.

One of the principal factors contributing to the present interest is the new street-car type of body now being introduced by bus builders. Another important element is the fact that, in some cities where tracks are being removed, the overhead construction can easily be adapted to the operation of trolley buses. The improvement in body design is traced to the popularity of gas-electric drive. The standard design of gas-electric bus can be converted to a modern trolley bus by eliminating the gasoline engine, generator, and 250-volt motors ordinarily employed and substituting an overhead collector, foot-operated control and two 600-volt motors. Proponents of the trackless trolley bus point out that electric power is much cheaper than gasoline, thus giving a distinct advantage to the former where definite routes are already established.

The trolley buses for Manila are the first of the new design. The drive used consists of two 35-hp., 600-volt motors and multiple-unit foot-operated control in connection with 11-to-1 worm gearing and 38-in. tires.

One of the New Trackless Trolley Buses

The Manila Electric Company has been operating trolley buses for a number of years and is convinced of their desirability, and the reports of other cities using this type of vehicle (Rochester and Cohoes, New York) indicate that the trolley bus is most economical and reliable in operation.

The trolley bus has the advantage of being able to maneuver eight or nine feet on either side of the overhead trolley, thus allowing it to go around obstructions or to pull up toward the curbing. This tends also to reduce accidents.

Science Abstracts 1915 Sec A
Jan 1916

rounding gas, *e.g.* a change from the moist air of the room to dried air or hydrogen (dry or not dry). In opposition to this it is found that there is an increase of the effect with Ag when the room air is changed for hydrogen. The largest values obtained with air are increased by means of the glow-discharge in hydrogen in the cases of Zn, Cd, Pb, Sn, Bi, Ni, Cu, Ag, Pt, Pd. With Cd it has been possible to obtain qualitative recovery and fatigue curves showing two maxima. The results taken as a whole seem to indicate that the photoelectric current depends upon two variables that are independent of one another, one variable being the condition (purity) of the metal surface, and the other the condition of the surface water-film. A. E. G.

1735. *Persistence of the Current in Photoelectric Cells after the Suppression of the Exciting Light.* **O. M. Corbino** and **G. C. Trabacchi.** (N. Cimento, 10. pp. 47–67, July–Aug., 1915.)—After the discontinuance of the light impinging on a photoelectric cell subjected to a p.d., a residual current persists; this is still detectable after the lapse of a period of the order of one-hundredth of a second, and diminishes the more rapidly the higher the p.d. applied. Thus, with a p.d. of about 80 volts, the current has about 0·085 times its normal value 0·06 sec. after the action of the light ceases. This residual current is due, not to posthumous emission of ions by the metal, but to the presence in the cell of ions created by shock which give rise to new ions before they are transferred to the electrodes. T. H. P.

1736. *Spontaneous Electron Emission from Glowing Metals and the Glow-electric Element.* **W. Schlichter.** (Ann. d. Physik, 47. 5. pp. 873–940, Aug. 5, 1915.)—After a brief introduction the following are the chief sections considered:—Relation of the present work to the researches which have taken place up to the present: Experiments on the spontaneous glow-electric emission; results obtained when using platinum; results obtained with nickel: The glow-electric element. The conclusions arrived at are that the glow-elements, as such, are possible. It is, however, quite uneconomical to use them on account of the disproportionately high radiation loss. A. E. G.

1737. *A New Group of Electric Light Appearances.* **E. Goldstein.** (Deutsch. Phys. Gesell., Verh. 17. 14. pp. 376–388, July 30, 1915.)—By the discharge of a Leyden jar which is fed by an inductor, a new kind of kathode ray is generated which differs in several particulars from the usual kathode rays. One of the most striking differences is the peculiar colour of the rays. These "jar rays" are also found to be much longer than the usual rays obtained with an inductor discharge at the same gas pressure; they are also less easily absorbed, and also less easily deviated by a magnet than ordinary kathode rays under like conditions. A. E. G.

1738. *Current-potential Curve for the Electric Light Effect.* **E. Hermann.** (Deutsch. Phys. Gesell. Verh. 16. 14. pp. 688–697, July 30, 1914.)—If, in an electric light apparatus, a test electrode is introduced behind the kathode, the test electrode being shielded from direct light, a loss of negative charge can be observed. Curves are here given showing the current from such a test electrode as a function of the field between the electrode and the neighbouring wall. The variations which the curve undergoes for different degrees of vacuum and for different materials of wall and electrode are also illustrated and the results are discussed. A. W.

PLAINTIFFS' EXHIBIT NO. 86.

U S DISTRICT COURT
86

THE
ASTROPHYSICAL JOURNAL
AN INTERNATIONAL REVIEW OF SPECTROSCOPY
AND ASTRONOMICAL PHYSICS

VOLUME XLVI NOVEMBER 1917 NUMBER 4

THE VARIATION WITH TIME OF THE CHARACTERISTICS OF A POTASSIUM PHOTO-ELECTRIC CELL AS TO SENSIBILITY ACCORDING TO WAVE-LENGTH

By HERBERT E. IVES

The measurements presented here were obtained during a study which was started with a twofold object: first, to try to work out a method of making photo-electric cells which would have the same characteristics of sensibility according to wave-length from cell to cell; secondly, to determine whether the spectral sensibility-curve remained constant with time and use.

A previous study,[1] part of a series planned to learn the possibilities of the photo-electric cell in photometry, established the fact that the distribution of sensibility through the spectrum varied greatly among cells made up in the manner usual at that time. If the proposition so to screen a cell as to make it equivalent to the eye is to have any practicability, it is essential that the cell's characteristics remain fixed; and if the manufacture of any considerable number is to be undertaken, it would be practically prohibitive to have to work out a separate correction for each cell. Hence the desirability of working out, if possible, a standardized cell of permanent characteristics.

[1] Ives, "Wave-Length Sensibility-Curves of Potassium Photo-Electric Cells," *Astrophysical Journal*, 40, 182, 1914.

The test for permanence giving disappointing results, as will be seen, the other portion of the study was necessarily abandoned,

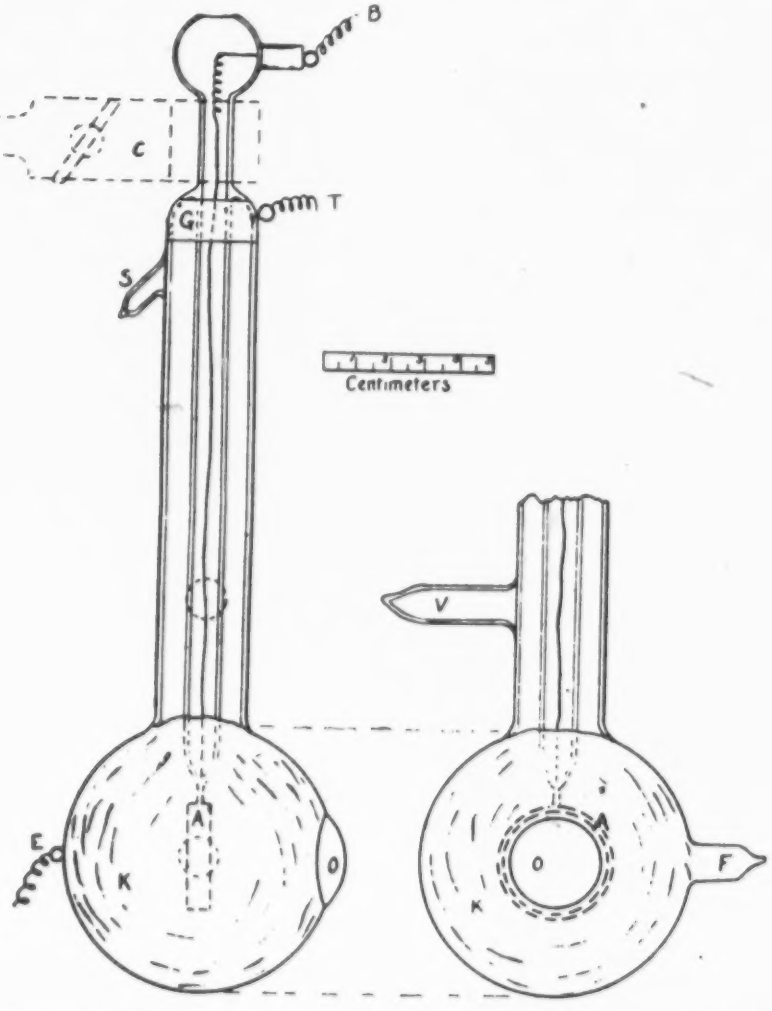


FIG. 1.—Photo-electric cell studied. *K*, Bulb whose inner surface coated with potassium forms the kathode; *A*, Anode; *E*, Electrometer connection; *O*, Opening for the admission of light; *F*, Filling tube; *V*, Evacuating tube; *S*, Tube used for silvering inner guard-ring; *G*, Guard-ring formed by interior and exterior silvering; *T*, Earth connection for guard-ring; *B*, Battery connection; *C*, Supporting clamp.

and work was limited to a single cell. Its design is shown in Fig. 1, with its accompanying legend. In general, it is made to conform

to the requirements for securing a rectilinear relationship between illumination and current as established by an earlier research,[1] namely, the reduction to a minimum of all surfaces on which charges can accumulate. The form adopted was the one described in the earlier paper as the Hughes design, that is, one in which the walls are covered with alkali metal, so that the whole cell approximates a black body. The choice of this form rather than of the Richardson design with the alkali metal at the center of the inclosure was dictated by the idea that the approximation to a black body might give the desired uniformity of characteristics from cell to cell. In order to secure sensibility all the way down to the red end of the spectrum, which is essential for photometric purposes, the cell was colored by a hydrogen glow discharge. This process was carried to the point where a maximum of sensibility was just passed, and all the conditions, such as voltage, pressure, etc., were carefully measured, so that they could be copied on subsequent cells. The resultant surface was dark blue in color. After the operation of coloring, the hydrogen was carefully pumped out, and helium was introduced to a pressure which gave the maximum sensibility as tested with the cell still on the pump. The curve of voltage-current of this cell was that characteristic of the gas-filled type—convex toward the voltage axis. The illumination-current relation was strictly rectilinear.

In testing the wave-length sensibility the light from a monochromatic illuminator was projected on to a piece of ground glass directly before the window of the cell, the idea being so to scatter the light that the average effect of all elements of the rather large area of potassium surface would be obtained.

The cell was mounted for test in a galvanized iron box which communicated with the electrometer inclosure, both being sealed air-tight with paraffin seals and well provided with drying material. During the whole period of the test neither cell, electrometer, nor monochromatic illuminator was disturbed in position. The source of light used was a standard 4.85 wpsc carbon lamp illuminating a ground glass before the slit of the monochromatic

[1] Ives, Dushman, and Karrer, "Factors Affecting the Relation between Photo-Electric Current and Illumination," *Astrophysical Journal*, 43, 9, 1916.

illuminator. This lamp was used for no other purpose and provided a source of radiation of practically perfect uniformity of spectral distribution throughout the period of the test.

Measurements through the spectrum were made at first every day, then weekly, and then irregularly at longer intervals. After the first two weeks the cell was continuously illuminated, by an auxiliary lamp, with current running for a period of two weeks, to determine whether use accelerated the rate of change already detected. No effect directly chargeable to use was found. Five of the curves of wave-length sensibility for 2, 36, 63, 93, and 220 days (after which the arrangement of apparatus was disturbed) are shown in Fig. 2. These are just as obtained, not corrected either for the distribution of energy in the source or for the dispersion of the spectrometer. They are plotted to equal values at their maxima.

It is shown by these curves that the wave-length sensibility suffers a continuous change with time. The exact nature of the change cannot be inferred from these data, as it may be either an increase in the sensibility for the long waves or a decrease for the short waves. Thus, if the curves of Fig. 2 are plotted to equality in the yellow or yellow-green region of the spectrum, they all appear to be practically coincident until the blue-green is reached, when the variation shows as a progressive decrease of sensibility with time. This point could only be settled by preserving the constancy of the current-sensibility of the apparatus throughout the test and working with an applied voltage accurately the same on each trial, which was not attempted. For the main purpose of the test—establishing permanency or lack of it—it is of small importance whether the variation is due to an increase or a decrease of sensibility in any given region.

While the measurements give no information as to the cause of this variation, the suggestion may be hazarded that what is taking place is a gradual sintering of the highly sensitive and presumably unstable colloidal or hydride colored surface. This, as is well known, loses its characteristics if the hydrogen atmosphere, used to form it, is left in the cell. According to Elster and Geitel, an atmosphere of inert gas (helium, argon, neon) prevents this deterio-

ration. The present work indicates that some change still takes place with helium as the gas of the cell. From the standpoint of permanence alone, probably a very different result would be obtained if the coloring of the surface were dispensed with and

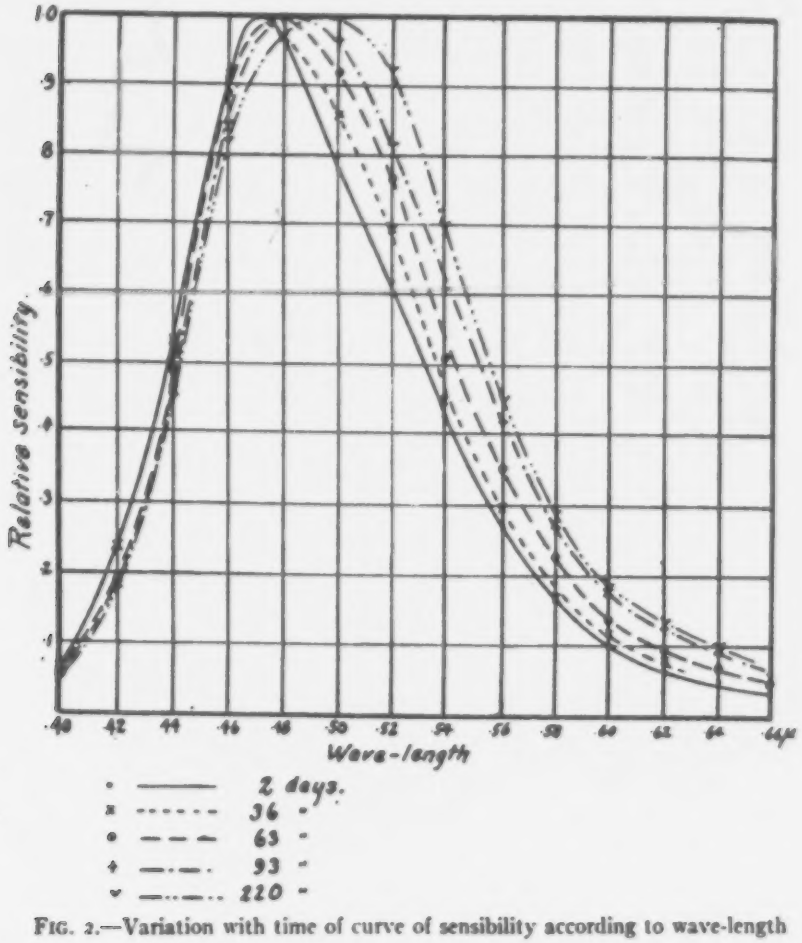


FIG. 2.—Variation with time of curve of sensibility according to wave-length

the potassium were simply made as pure and clean as possible by multiple distillation in vacuo. Pure potassium, however, is insensitive beyond 0.6 μ and so would be useless for the photometric purpose in view. Rubidium is sensitive farther into the red, but not far enough, while caesium, sensitive still farther, is too rare and of too low melting-point to be considered seriously.

It appears from this work that the prospect is not bright of making permanent cells of standardized characteristics. Consequently the practical fabrication of cells screened to imitate the human eye is not as yet feasible.

This investigation forms the conclusion of the series begun by the writer some years ago, aimed specifically at applying the photoelectric cell to photometry. For this purpose the cell should have certain characteristics. It should first of all exhibit a simple uniform relation between illumination and current. Next, it should have a curve of the relation between wave-length and sensibility which could be modified by screening so as to duplicate that of the average eye. The cell and its auxiliaries should, in addition, be sensitive, simple to use, and permanent. With regard to the first point, the writer's work[1] showed that in cells as ordinarily constructed, the relation of illumination and current was very erratic from cell to cell. Later[2] the explanation for this was found in the fact that whenever opportunity was offered for electrical charges to accumulate on free glass surfaces in the cell the current would be affected. Cells in which the relation of illumination and current could be altered at will were constructed. This led to the statement of the conditions necessary for a rectilinear relation of illumination and current, namely, the elimination, as far as possible, of such free glass surfaces, and to the production of cells possessing the desired relationship. The second point is covered by the measurements of curves of sensibility with wave-length of a series of cells, published some time ago,[3] and by the experimental work of the present paper.

The net result of this whole research is to show that the photoelectric cell is inapplicable at present to photometry, where by *photometry* is meant the measurement of luminous flux, that is, radiant flux evaluated according to its capacity to produce the

[1] Ives, "The Illumination-Current Relationship in Potassium Photo-Electric Cells," *Astrophysical Journal*, 39, 428, 1914.

[2] Ives, Dushman, and Karrer, "Factors Affecting the Relation between Photo-Electric Current and Illumination," *Astrophysical Journal*, 43, 9, 1916.

[3] Ives, "Wave-Length Sensibility-Curves of Potassium Photo-Electric Cells," *Astrophysical Journal*, 40, 182, 1914.

sensation of light. The answer is quite different, however, in so far as *radiometry* is concerned, where under radiometry we include those measurements often treated under photometry, in which the characteristics of the radiometer as to sensibility according to wave-length do not enter. Such, for instance, are measurements of distribution of radiant flux, etc., for which the only requirement is the rectilinear relationship of illumination and current and adequate sensibility.

Among radiometric applications for which the properly constructed photo-electric cell is well suited may be noted, in particular, variations in intensity of certain types of stars, distribution curves of illuminants, densities of photographic plates, and finally spectro-radiometry in the visible and ultra-violet regions where the non-selective radiometers and the eye are too insensitive. For this latter purpose it is necessary, in order to get sufficient sensibility to make such measurements as those of diffuse reflecting power, to use an electrometer, or possibly a highly sensitive Thomson galvanometer. Some means of amplifying the current similar to those used in wireless telegraphy, to bring it into the range of the simple d'Arsonval galvanometer, would be a great boon. Some experiments made for the writer some time ago by Dr. A. W. Hull, of the General Electric Research Laboratory, showed the entire feasibility of amplifying photo-electric currents by the electron tube amplifiers developed in that laboratory. But while amplification of a thousand fold or more presented no difficulty, these amplifications were of currents already large enough to be measured by a sensitive d'Arsonval galvanometer. Small currents, of the order of magnitude measured by the electrometer, presented great difficulty, owing to leakage and other troubles in the amplifiers. Further work along this line is desirable.

Another improvement in the cell to make it applicable to spectro-radiometry would be to master the technique of producing a flat, extended curve of sensibility with wave-length, such as one of those accidentally found in one of the cells measured in the work quoted.[1] The very sharp maximum of the more usual type, such as that exhibited by the cell reported on in this paper, is

[1] *Ibid.*

undesirable, necessitating very narrow slit-widths to avoid corrections.

These points have been discussed in part to emphasize the necessary distinction between the very valuable characteristics of the photo-electric cell in *radiometry* and its failure in *photometry*. For the latter the only physical instrument so far developed is the screened non-selective radiometer, e.g., thermopile.[1]

PHYSICAL LABORATORY
THE UNITED GAS IMPROVEMENT COMPANY
PHILADELPHIA, PA.
September 25, 1917

[1] Ives and Kingsbury, "Physical Photometry with a Thermopile Artificial Eye," *Physical Review*, 6, 319, 1915.

PLAINTIFFS' EXHIBIT NO. 87.

Copy of File Wrapper and Contents of Heisler Patent No. 1,771,922.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 88.

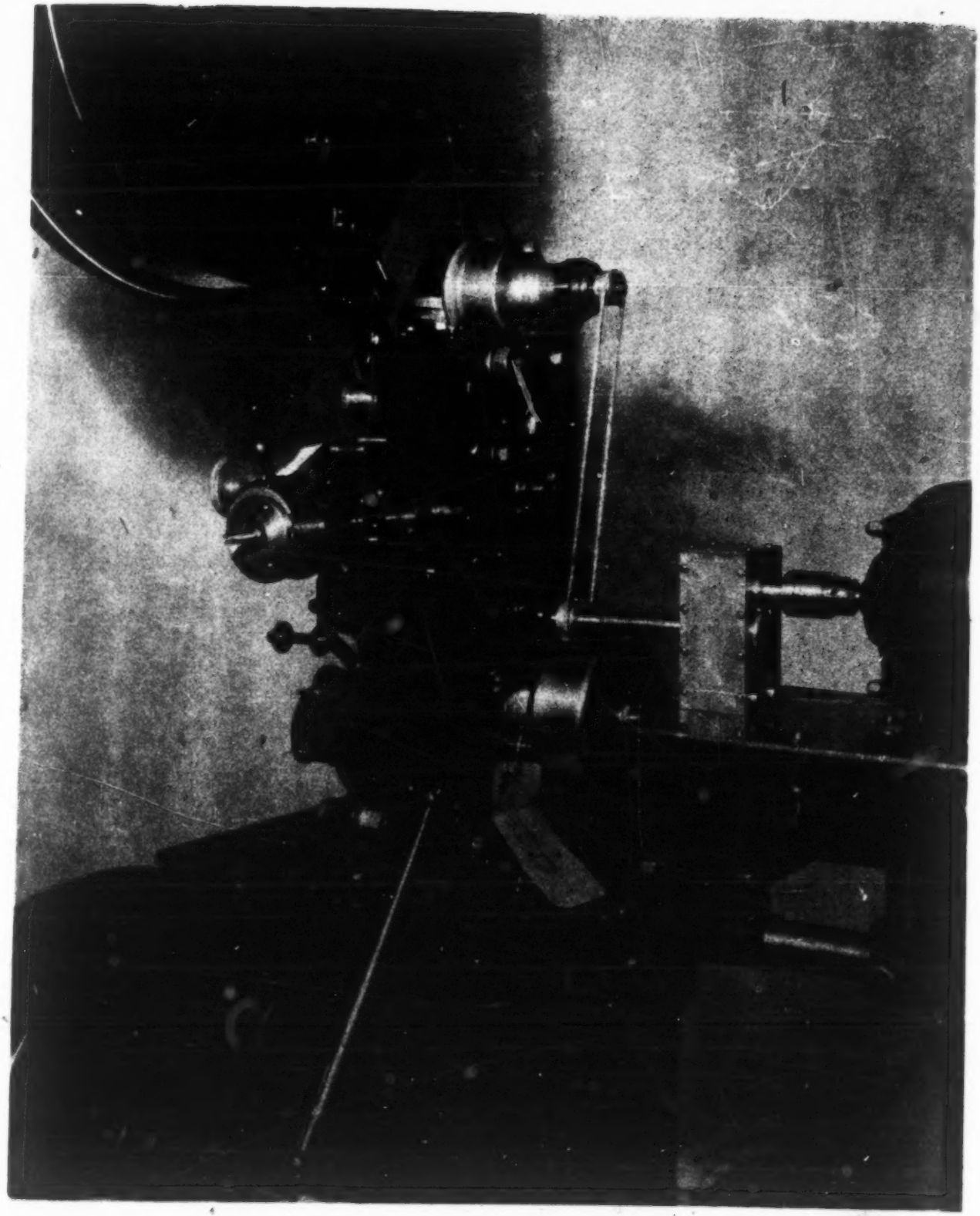
Copy of File Wrapper and Contents of Heisler Patent No. 1,793,399.

(Physical Exhibit.)

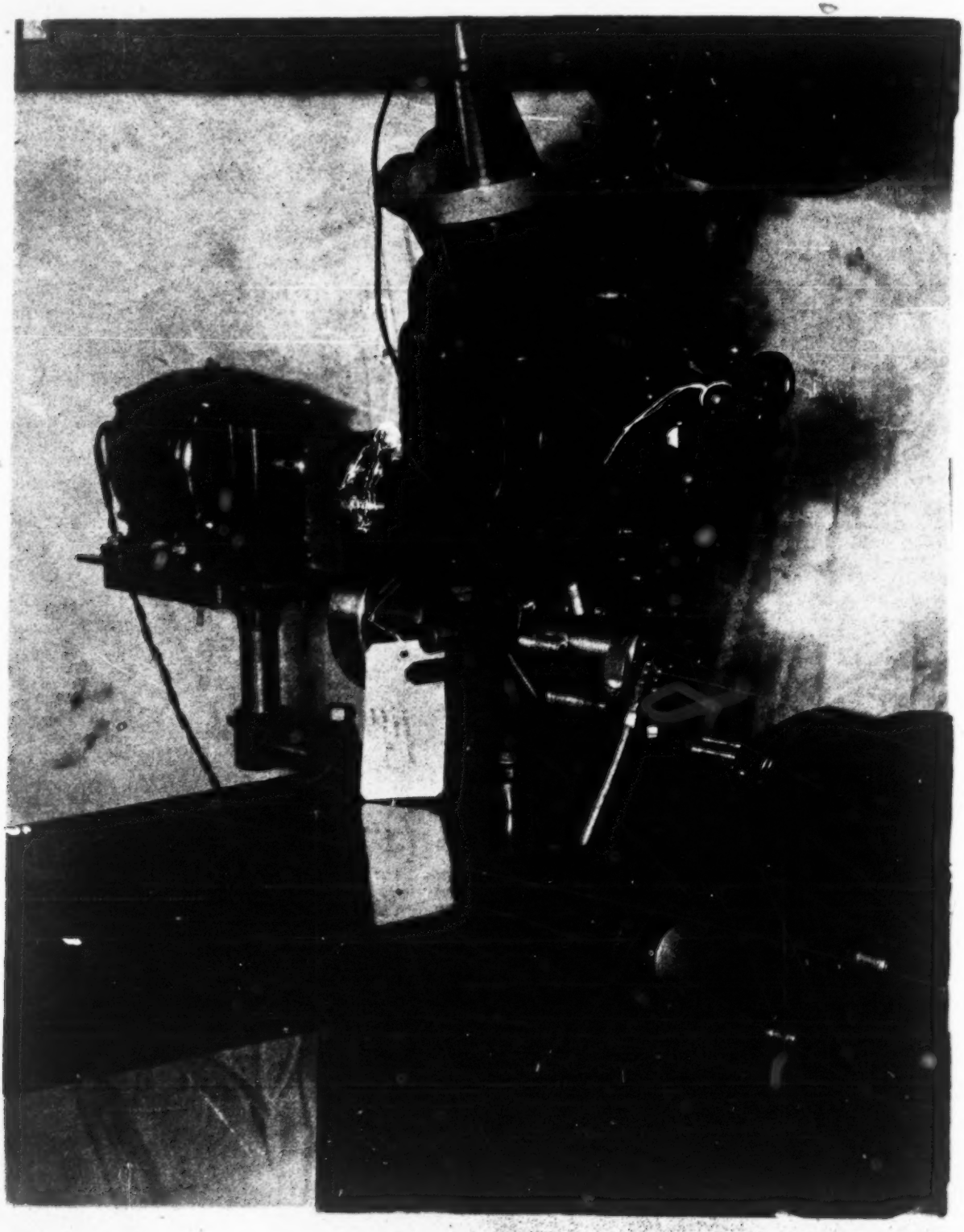
PLAINTIFFS' EXHIBIT NO. 89.

Tri-Ergon Sound and Picture Head, Corresponding to Figs. 3, 4, 5 and 6 of Patent in Suit, as Demonstrated.

(Physical Exhibit.)



PLAINTIFFS' EXHIBIT NO. 90-B.



PLAINTIFFS' EXHIBIT NO. 91.

Pair of New Helical Gears Referred to by Witness Ballard and Used in Last Demonstration of Plaintiffs' Exhibit No. 89 Machine.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 92.

Spring Used Between Flywheel and Arm in Plaintiffs' Last Demonstration of Exhibit No. 89 Machine.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 93.

Sound and Picture Head of Second Tri-Ergon Machine as Demonstrated, With Film Movement Representing Figure 2 of Patent in Suit.

(Physical Exhibit.)

PLAINTIFFS' EXHIBIT NO. 94.

6. Low pass filters suppressing frequencies above 1,250;
7. No filters.

This clearly demonstrates in the case of speech and music that the volume of sound rests with the low frequencies, and that the low frequencies in speech and music are therefore important. It also demonstrates that the higher frequencies are important in speech from an intelligibility standpoint, and that they provide the brilliance in piano music. High frequencies are, therefore, equally important, and the necessity for a straight line characteristic of both recording and reproducing is therefore established.

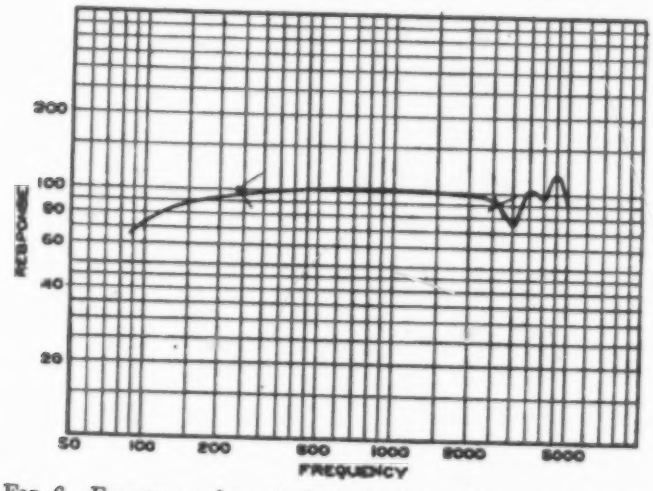


FIG. 6. Frequency characteristic of public address amplifiers.

Fig. 6 shows frequency characteristic of Public Address amplifiers with a carbon button transmitter. While this curve is not a straight line over the entire range, we are pleased to call it a straight line characteristic, particularly since the diversions from the straight line are small in comparison with the variations of the human ear as indicated above.

Fig. 7 shows the characteristics of a Condenser Transmitter with its amplifier plotted to a logarithm scale. It is interesting to note that the characteristics of this microphone are better than shown in the previous diagram, in that they do not discriminate as much against the low or certain high frequencies.

Given means for faithfully recording sound and means for faithful reproduction of sound and means for the faithful recording and

U. S. DISTRICT COURT
M. D. PENN.
COMPL. EX. 94